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INSTRUMENTS

INDUSTRIAL — SCIENTIFIC

Devoted to the Instrument Problems of all Industries

Vol. 1. No. 10 Pittsburgh, Pa. October, 1928

IN THIS ISSUE

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The "Turbine" Steam Meter.
JOHN M. HODGSON, EGGINGTON, ENGLAND

The Measurement of Temperature.
RICHARD RIMBACH

The Radiation Pyrometer.
MAX HARTENHEIM, PITTSBURGH, PA.

New Instruments.
The Standco Model "D M" Megohmer.
The "Cajo" Gas Leak Indicator.
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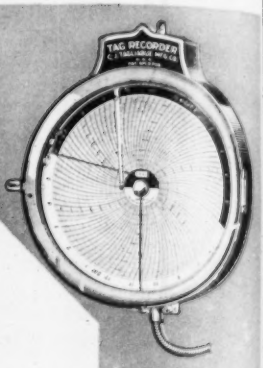

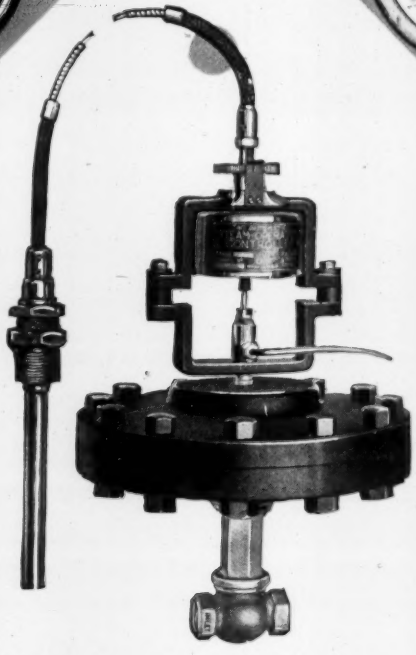

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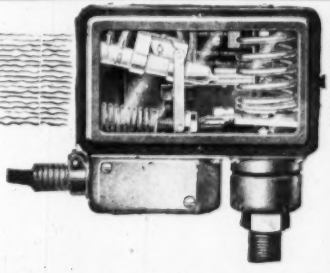

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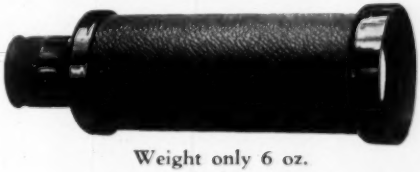

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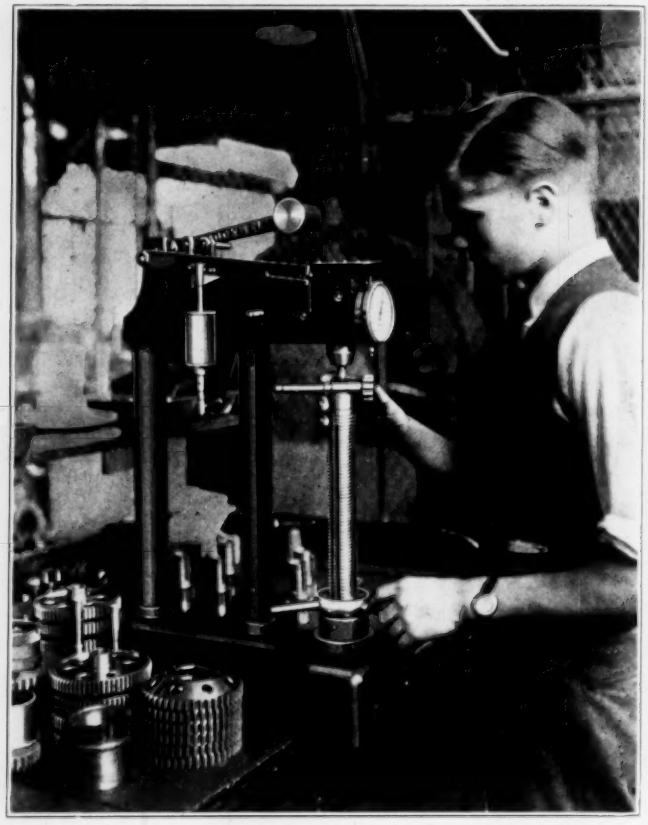

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Vol. 1 No. 10 OCTOBER 1928 Pittsburgh, Pa.

To Our Readers

THE editor would call the attention of the readers to the fact that it is not possible for the advertisers to list all the instruments or measuring devices manufactured by them in their advertisement. They usually use their advertising space to call attention to some new developments they have made, special features of their products, the opinions of users of their instruments, etc. The Buyers' Guide lists the various instruments for measurement, inspection and control manufactured by the companies advertising in INSTRUMENTS and is the only instrument index available at present.

The reader can refer to this index when he desires information as to sources of supply of instruments. The companies listed there will be more than glad to furnish information on their instruments.

INSTRUMENTS has a very complete index covering some 2,000 instrument items, therefore, if the information you desire is not shown in the Buyers' Guide send your inquiry to the Information Section. This section will supply the information to you promptly without charge. All questions, which cannot be answered immediately are numbered and listed in the Information Section. To-date over 300 inquiries have been answered.

The Buyer's Guide in the January issue promises to be especially complete and all those who have any use for such information would do well to send us their subscription now. The same holds true for renewals. If your subscription to INSTRUMENTS expires with the December issue of this year—send us your renewal immediately.

——::——

The Measurement of Temperature

THAT industrial progress and improvement of product are only possible by the use of instruments, will be permitted by everyone in industry. The advances of recent years are largely due to improved facilities for accurate measurement. Although the truth of this statement is admitted, it must also be admitted that many old established companies are running the risk of being outstripped in production efficiency by competitors, who install the latest instruments for measurement and control, to assist their workmen.

The measurement of temperature is an outstanding example of the successful application of measurement. Only by the systematic use of suitable instruments can good results be duplicated and failure be avoided with certainty and regularity.

The choice of instruments for measuring temperature depends on a great number of factors. These are temperature range over which the measurements are to be made, the required accuracy, the necessary sensitivity, whether the instrument is to be used for indicating, recording or control or all three, initial cost, maintenance costs, conditions to be satisfied when installing, etc. It is generally advisable to consult some one with training and experience in the use of temperature measuring instruments. Instruments engineers are becoming more numerous and they have contributed much to the extensive use of temperature measuring instruments in modern industry.

———— :: ————

Instruments—Use More of Them

IT was not so many years ago that instruments were regarded as a luxury in the factory. A few thermometers, or possibly pressure gauges were all the instruments available. When other instruments were purchased they were often hidden away in other requisitions or on repair orders. In some cases when orders for a limited amount could be placed without official sanction, a series of orders would have to be issued before the instruments were paid for.

In some measure the instrument companies were to blame, as some of the instruments were not sturdy enough to function under operating conditions and soon got out of order. Some salesmen pictured instruments as a cure-all and when the operating man found that promised results did not materialize, he lost faith. Even at present it is not uncommon to see instruments not operating and covered with dust, in some cases dismantled and placed in the stockroom or thrown in the scrap heap.

The man in the plant was to blame as he expected the instrument to do his thinking for him. In many cases incompetent workmen were used to install the equipment without regard for the instructions for installation sent with the equipment. These and other factors were responsible for early failures. The manufacturer's instructions for installation and operation should be followed implicitly; the men should study the literature and make use of the service departments, which are always ready to straighten out difficulties.

The instrument industry is now so far advanced that excellent instruments are manufactured for every purpose. Today's instruments are rugged and built to require minimum care; they do require some attention. The instructions issued with the instrument specify the items which must be maintained by periodic inspection.

No instrument will last indefinitely and it is surprising that so many are operating satisfactorily in spite of the lack of attention. Even an ordinary pressure gauge should be checked from time to time.

Supervision is not difficult, but, like everything worth doing, it is worth doing well. It is a simple matter to list the instruments in the plant and fix an inspection routine, assigning the task to one man. Occasional cleaning will often prevent serious failure. If the plant is too small to employ a man capable of looking after the instruments, it would be advisable to either pay the manufacturer a service charge to look after the instruments periodically or employ an instrument service company or testing laboratory to do this work.

———— :: ————

What is Advertising?

TO an advertising manager, it is a profession, a great force in the development of the human race. Advertising is that channel through which those who need to purchase something can get in touch with those who have that particular thing to sell—*be it brains, service or goods.*

From discussions with many different people on advertising, the editor has come to the conclusion that the man who "doesn't believe in advertising" is almost invariably the most blatant of advertisers—but usually blissfully ignorant of the fact.

Imagine how pride would swell up in the breast of some on seeing something like the following announcement in the "Podunk Tatler."

"Mr. George Babbitt the well known manufacturer of thermometers, was observed handing around tea and cake to the ladies at the weekly gathering of the Tuesday Afternoon Club."

Try and get them to repeat something similar at so much per line the following week, and they would become too dangerous to approach again for sometime.

———— :: ————

As was stated on page 387 of the September issue of Instruments, a series of articles will be written, by Mr. H. L. Hazeltine, Engineer of Insulation, Sterling Varnish Company, on the practical testing of varnishes, compounds, paints, enamels, etc. This series will start in the November issue.

So as not to miss a single issue of this series, send in your subscription on the blank provided for this in the back of this book.

———— :: ————

To the Instrument Companies

IN order to keep the readers of INSTRUMENTS in touch with the latest developments in industrial and scientific instruments, the editor again urges all manufacturers of such instruments to keep him informed of all new instruments or important improvements made by them as soon as they appear, by letting him have descriptions of about 1000 words including construction, performance, and applications.

Instruments Collaborators

Prof. F. C. Ashe, Head of Electrical Equipment and Construction Department, Carnegie Institute of Technology, Pittsburgh, Pa.

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Prof. W. R. Work, Head of the Department of Electrical Engineering, Carnegie Institute of Technology, Pittsburgh, Pa.

C. B. Wright, Supt. Power Distribution, Duquesne Light Company, Pittsburgh, Pa.

Instrument Pioneers

Morris M. Titterington
(1891-1928)

MORRIS M. TITTERINGTON was born at Paris, Texas, on July 20, 1891. His parents were George A. and Lena Titterington.

Titterington received his early training in the Dallas High School. Later he attended the University of Dallas, and graduated from the Bliss Electrical School, Washington, D. C. in 1912.

All his interests were centered in aeronautics and in 1912 he built his own airplane. The next year he went to work for the Curtiss Aeroplane Company and at that time learned to fly in the Curtiss School at Hammondsport, New York.

Impressed with the importance of instruments as an aid to the aviator, he devised some instruments for his own airplane. On leaving the Curtiss Company in 1914 he went to the Sperry Gyroscope Company where he worked in conjunction with Lawrence Sperry on the automatic airplane stabilizer and other instruments.

In 1915, Titterington was sent to England and represented the Sperry Gyroscope Company in England and France during 1915 and 1916, returning to the United States in 1917, as Chief Engineer of their aircraft instrument department. Considerable work on the development and improvement of aircraft instruments was done under his direction.

Titterington appreciated the necessity for the organization of a separate company to carry on this work and in 1919 assisted in bringing about the organization of the Pioneer Instrument Company. In 1920 he joined the company as Vice-President and Chief Engineer, which positions he filled so brilliantly until his death.

He lost his life in an airplane accident on the afternoon of July 11, 1928. He had started on a flying vacation trip, which was planned to include visits to many cities between New York and Los Angeles. Within two hours after leaving Curtiss Field, New York, he encountered a thunder storm in eastern Pennsylvania, and apparently his plane was struck by lightning.

The most interesting and perhaps the most important instrument for use in aviation, the earth inductor compass, was invented by Titterington. This instrument enabled Lindbergh and "The Spirit of St. Louis," to reach the Irish coast at a point only three miles from the planned course. Other instruments invented and developed by him were the flight indicator, the air distance recorder and the Pioneer hydrostatic fuel level gauge.

Contents of Subsequent Issues

Historical Sketches of Men who have contributed to the advancement of the Instrument Science.

Instruments and Methods of Determining Flash Point.

Dilatometry.

Temperature Control in Process Industries.

Correct Connections for Polyphase Watt Meters.

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Optical Pyrometry.

The Importance of Measurements in the Power Plant

The Care of Measuring Instruments.

Equipment Used in Aerial Surveying.

Automatic Control of High Temperatures.

Instruments for Geodetic Prospecting.

The Measurement of Pressure.

Speed Recording Instruments

New Inventions Needed.

Instruments applied to the Open Hearth for Efficiency.

Mechanical Vibrations and Their Measurement.

Instruments to improve Diesel Engine Efficiency.

Comparison of Instruments for Measuring Hardness.

The "Turbine" Steam Meter

By John M. Hodgson, M. Inst. Mech. E.

ORIGIN OF METER

SOME thirteen years ago, at the beginning of the war, the writer carried out a large number of tests on model propellers with the plane of rotation inclined at various angles to the direction of motion, in order to ascertain whether flight on the helicopter principle was practicable.* His conclusion, which still holds good, was that horizontal flight was possible, but that vertical flight was impracticable with a screw-supported machine using engines of the existing weight per horse-power. The model propellers tested were rotated by a small air turbine, the driving torque of which was determined by calibration in terms of the air pressure at the jet driving the turbine. It is from this turbine that the turbine steam meter has grown.

It was found during the above experiments that over a very large range of speeds the revolutions of the turbine were exactly proportional to the volume of air passed through the impact nozzles, and that it was only at low speeds, when the energy delivered to the turbine per second was small, that the constancy of the ratio of air volume to revolutions fell off. That this should be the case can also be shown by theory.

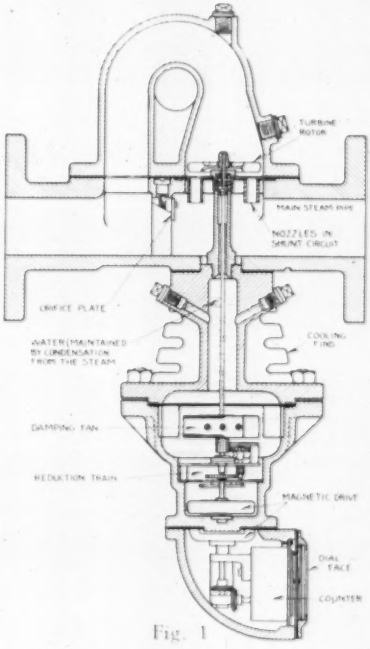

Fig. 1

Being at the time interested in the bulk measurement of air, gas, and steam, the writer realized that the jet-driven turbine gave the simplest means of obtaining a counter record of the flows of all these fluids. He saw that in a turbine meter only one freely rotating shaft (apart from the counter train) had to be designed so that its frictional resistance to rotation would remain negligible after months of running.

It has been his good fortune since the 1915 experiments to develop

*See "Some Tests of Model Propellers," Proceedings of the Institute of Automobile Engineers, 1917, pp. 261-304.

successful and accurate meters on the turbine principle for measuring each of the fluids above referred to.

DESCRIPTION OF METER

The turbine steam meter, which is already well-known in England, is illustrated in Figs. 1, 2 and 3.

The meter is shown in section in Fig. 1, and consists of a turbine driven by steam which impinges on its from two symmetrically placed nozzles. The turbine works in a shunt circuit, the main body of the steam going through an orifice, the size of which can be varied according to the maximum flow it is desired to meter.

The speed of the turbine is kept low (and hence the wear on the bearings is reduced to a minimum) by means of a damping fan which rotates in water contained in a chamber provided with radiating fins situated beneath the steam main. The retarding torque due to the liquid damping is made sufficiently large to mask the effect of the torque due to the rotation of the slow moving turbine in the steam, so that a 1 percent change in the density of the steam involves exactly a ½ percent change in the value of the corrective factor covering changes in the density of the steam.

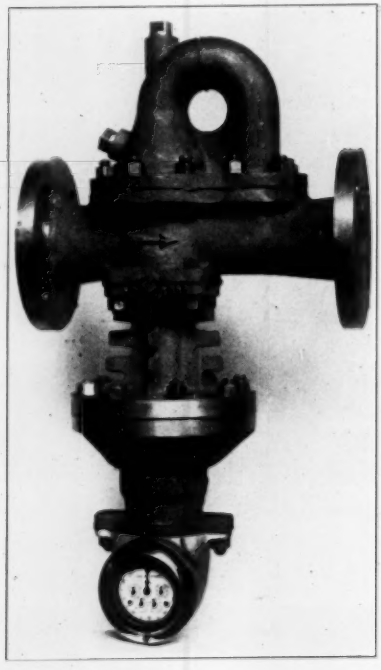

Fig. 2

It will thus be seen that unless the pressure varies over a large range, it is not necessary to fit the meter with an automatic pressure correcting device, which can, however, be supplied.

The motion of the turbine is transmitted to the counter dial by means of a magnetic drive which entirely eliminates all gland friction or leakage. Fig. 2 shows an outside view of the meter.

OVERLOADING THE METER

The meter is designed to stand considerable overloads. It can be subjected to, and will measure accurately, temporary overloads of as much as 100 percent. This overload capacity is of great use in those cases where it is essential to measure steam-flows over a large range, as is the

case when heating up vulcanizing pans with steam. Here it is desirable to ascertain the rate of steam-flow, both when initially filling the pan and when maintaining leakages and radiation losses.

The meter can be used for measuring large flows by installing it on a by-pass across an orifice placed in the main to be metered; the orifice in the meter itself being blocked up. An external view of the meter so installed in a vertical main is shown in Fig. 3.

MEASUREMENT OF PULSATING FLOWS

The meter is subject to slight error when the flow is violently pulsating. Serious error due to pulsation can usually be avoided by installing the meter so that there is a "capacity" between it and the source of pulsation.

It is not necessary to stress the value of a meter which can be used for measuring the steam consumption of rolling mill engines, steam winding engines, steam hoists, and other large reciprocating prime movers. Thus large steam losses caused by the wear of the valve-seats and pins of the operating mechanisms of the Corliss valves of steam winding engines are immediately brought to light by the use of this meter.

MAINTENANCE OF THE METER

In practice, the meter is found to maintain its accuracy down to one-tenth of its rated maximum flow for periods of arduous running exceeding one year, the worn parts being replaced at the cost of less than $1 and about an hour's work.

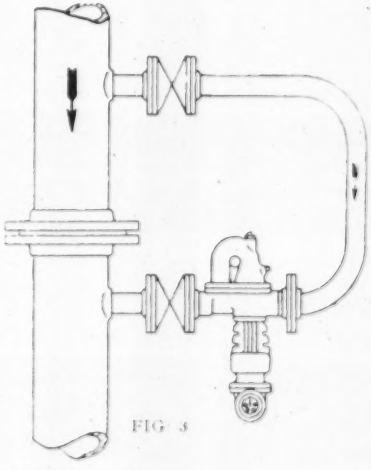

FIG. 3

LOSS OF PRESSURE DUE TO THE METER

The loss of pressure due to the meter when measuring steam is about 2 pounds per square inch at full flow, ½ pound per square inch at half flow, and so on.

APPLICATIONS OF THE METER

The turbine steam meter has the advantage over all other types of steam meter (for some of which the writer is responsible) that it is the most simple meter to read and to install. It therefore enables steam meters to be used in situations where skilled attention is not available. Further, because of its low cost (its cost is less than that of any other steam meter), it enables small steam mains to be metered. For these reasons it, besides

being a competitor to the established types of steam meters in their existing fields, opens up entirely new fields for steam metering. The dyeing, laundry, paper, textile, steel, chemical and paper-making industries all find this meter of value to them.

Turbine steam meters are in use which work successfully up to pressures of 300 lbs. per square inch, and up to temperatures of 600 deg. F. The turbine steam meter can be used without modification for recording air or gas consumptions.

THE FLOWS THAT CAN BE METERED

The normal maximum steam flows that can be measured through a 2 inch meter are as follows:

Gauge Pressure in lbs. per sq. inch	Rated Capacity in lbs. per hour
10	1,000
50	2,000
100	4,000
225	6,000
300	7,000

Maximum flows down to one-tenth of those tabulated can be chosen. The meter will register accurately down to one-tenth of these flows and up to 100 percent above them. The corresponding air flows in cubic feet per minute at each pressure are about one-third of the figures tabulated. For larger meters than the 2 inch, the increase in the rated maximum flows is approximately proportional to the increase in the area of the mains.

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The Measurement of Temperature

Richard Rimbach

THE author has tried to pick from the vast amount of information he has available in his library the more valuable. He wishes to take this opportunity to thank the following companies for their co-operation by furnishing the requested information: American Radiator Company, American Schaeffer & Budenberg Corporation, Automatic Electric Heater Company, Bristol Company, Colonial Supply Company, Fisher Scientific Company, Foxboro Company, Henry J. Green, Motometer Company, Pyrometer Instrument Company, Sarco Company, Standard Thermometer Company, Harold E. Trent Company, C. J. Tagliabue Manufacturing Company, Taylor Instrument Companies and Wilson-Maeulen Company.

The measurement of temperature is of the utmost importance in all industrial processes as the success of certain processes and reactions is largely dependent upon the control of temperature within certain limits, while in other cases an increase of temperature above a certain value means increased heat loss. The value of an exact knowledge or control of temperature is therefore being appreciated more and more. Since most engineers have to do with the measurement and control of temperature in industrial operations, this series of articles will be confined to the industrial needs.

Often such articles as this bring out nothing new; they simply help to make known more generally facts, that have been known to only a few men; but as these facts can be of value only when utilized, and the more widely they are known the more generally they are likely to be utilized, such discussions have a real value.

The articles which will appear in future issues are not intended as a theoretical consideration of temperature measurement or to enter into competition with the good books already available on this subject. They will show the engineer the usefulness of measurement and control of temperature for manifold purposes. In keeping with this object the articles will therefore avoid in so far as this is possible, theoretical discussions.

Widely different properties of certain substances which vary with temperature have been used or proposed for the measurement of temperature:

Change of length and volume of various substances.
Variation in the pressure of gas and vapors.
Melting points of different substances in cooling.
Color emitted light.
Change of electrical resistance and thermoelectric behavior.
Heat conductivity, etc.

Temperature measurements may be classified into two groups, each have several divisions and sub-divisions. There is a conflict of the terms thermometry and pyrometry, which is probably due to the fact that originally a pyrometer was understood to be an instrument for measuring temperatures above the range of the mercury thermometer. At the present time, however, the ranges overlap (see the classification below), pyrometers are not only used to measure the temperature above the range of the thermometer, but also to a much lower temperature, while certain of the thermometers measure temperatures within the pyrometer range. In the following classification, the pyrometric terms as adopted by the Industrial Group of the American Association of Scientific Apparatus Makers is used.*

The following company literature gives very complete application indexes for various temperature measuring, recording and control devices:

General—Bulletin 950C, C. J. Tagliabue Mfg. Co., Page 18.

Blast Furnace, Coke Oven, By-Product and Steel Plant—Bulletin 336, Bristol Company, Pages 4 to 16.

Steam Power Plants—Catalog Part 1, Taylor Instrument Cos., Pages 4 to 6.

Power Plants—List 1[illegible]906, Cambridge Instrument Co., Pages 6 and 7.

Gas Plants—Catalog Part 600, Taylor Instrument Cos., Pages 4 to 6.

Oil Industry—Catalog Part 1700, Taylor Instrument Cos., Pages 4 to 14.

Rubber Industry—Catalog Part 2, Taylor Instrument Cos., Pages 4 to 6.

Textile Industry—Catalog Part 3, Taylor Instrument Cos., Pages 4 to 11.

Meat Packing Industry—Catalog Part 500P, Taylor Instrument Cos., Pages 2 and 3.

Baking Industry—Catalog Part 900B, Taylor Instrument Cos., Page 2.

Sugar Industry—Catalog Part 200, Taylor Instrument Cos., Page 3.

*1—**Thermometer.** A device for measuring temperatures.

2—**Pyrometer.** A device for measuring high temperatures. The term is applied to those devices, the principal use of which is for measuring temperatures above a red heat (about 500 degrees C. [932 degrees F.]).

3—**Resistance Thermometer.** A thermometer which indicates temperature by means of the change with temperature of electrical resistance of one of its parts. It is a pyrometer when used at high temperatures (above 500 degrees C. [932 degrees F.]), and in such case is preferably called resistance pyrometer.

4—**Radiation Pyrometer.** A pyrometer which indicates temperature by means of the change with temperature of the heat radiated by a hot body. As nearly as possible the total heat radiated is used. Usually this temperature is measured by a thermocouple.

5—**Optical Pyrometer.** A pyrometer which indicates temperature by means of the change with temperature of the light emitted by a hot body. As nearly as possible light of a single color (wave length) is ordinarily used.

6—**Thermocouple.** A pair of electrical conductors so joined as to produce a thermal e.m.f. when the junctions are at different temperatures. It consists of conductors of different material permanently joined at one end, the other ends being free to connect to an instrument for measuring e.m.f.

7—**Thermoelectric Pyrometer.** A pyrometer which indicates temperature by means of the change with temperature of the e.m.f. of a thermocouple. It ordinarily consists of a thermocouple, a millivoltmeter (or other means of measuring e.m.f.) and connecting leads. The measuring instruments may be classified as follows: Millivoltmeters; potentiometers; their combination or modifications.

Classification of Industrial Temperature Measuring Instruments

CONTACT

Expansion Thermometry

1. Expansion of Gases		
Pressure:	Nitrogen,	— 200 to + 1000°F (— 130 to + 540°C)
2. Expansion of Liquids		
Liquid in Glass:	Mercury,	— 30 to + 1000°F (— 30 to + 540°C)
	Alcohol,	— 100 to + 250°F (— 70 to + 120°C)
	Pentane,	— 300 to + 70°F (— 180 to + 20°C)
Pressure:	Methyl Alcohol,	— 60 to + 150°F (— 50 to + 70°C)
	Zylene,	— 40 to + 750°F (— 40 to + 400°C)
	Mercury,	— 40 to + 1000°F (— 40 to + 540°C)
	Methyl Chloride,	— 30 to + 100°F (— 30 to + 40°C)
	Iso-Butane,	— 5 to + 95°F (— 20 to + 35°C)
	Normal Butane,	+ 15 to + 120°F (— 10 to + 120°C)
	Ethyl Chloride,	+ 30 to + 150°F (0 to + 65°C)
	Heavy Hydro Carbon Oil,	+ 40 to + 300°F (+ 10 to + 150°C)
	Ether	+ 70 to + 195°F (+ 20 to + 90°C)
	Acetone,	+ 110 to + 235°F (+ 40 to + 110°C)
	Ethyl Alcohol,	+ 155 to + 260°F (+ 70 to + 130°C)
	Butyl Alcohol,	+ 220 to + 345°F (+ 100 to + 180°C)
	Aniline,	+ 320 to + 465°F (+ 160 to + 240°C)
Vapor Pressure:	Sulphur Dioxide,	— 20 to + 250°F (— 30 to + 120°C)
	Ether,	+ 50 to + 300°F (+ 10 to + 150°C)
	Alcohol,	+ 150 to + 400°F (+ 65 to + 200°C)
3. Expansion of Solids		
Bimetallic:	Rubber and Copper Discs,	+ 80 to + 140°F (+ 25 to + 60°C)
	Bimetallic Bar,	+ 80 to + 160°F (+ 25 to + 70°C)
	Silica and Monel,	+ 200 to + 1200°F (+ 90 to + 650°C)

Electrical Resistance Thermometry

1. Base Metal		
	Copper, Nickel,	— 300 to + 250°F (— 180 to + 120°C)
2. Rare Metal		
	Platinum,	— 300 to + 1800°F (— 180 to + 1000°C)

Thermoelectric Pyrometry

1. Base Metal		
	Copper Constantan,	+ 32 to + 700°F (0 to + 370°C)
	Iron Constantan,	+ 32 to + 1300°F (0 to + 700°C)
	Nickel-Chrome Constantan,	+ 32 to + 1700°F (0 to + 900°C)
	Nickel Nickel-Chrome,	+ 32 to + 1900°F (0 to + 1000°C)
2. Rare Metal		
	Platinum Platinum-Rhodium,	+ 32 to 3000°F (0 to + 1600°C)
	Platinum Platinum-Iridium,	+ 32 to 2200°F (0 to + 1200°C)*

DISTANCE

Radiation Pyrometry,	Over 1000°F (500°C)
Optical Pyrometry,	Over 1100°F (600°C)

*Seldom used.

Confectionery Industry—Catalog Part 900C, Taylor Instrument Cos., Page 2.

Refrigeration and Cold Storage Plants—Catalog Part 300, Taylor Instrument Cos., Page 8.

Most instruments can be supplied for indicating, recording and control, or any combination of these three. Usually, recording instruments should be used for all important locations as they give a permanent record of conditions which can be filed for future reference and analyzed whenever desired. If the recorders are properly installed and maintained, they are more reliable than periodic readings placed on a log sheet from indicating instruments as not only do they eliminate the human factor with its possibility of error, but give a record of the conditions at all times so that in case of accident or poor operation, records are available for a thorough analysis.

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ON August 15th, The Brown Instrument Company, Philadelphia, started operations on extensive improvements to its heating plant, including enlargement of the building housing the boiler room and increase of boiler capacity.

Plans for building alterations include a new floor level and the supporting of the roof on steel instead of wood. Space will be provided for a complete steam plant of sufficient capacity to heat a building having floor space equal to three times that of the present building, now occupied by this company.

One H. B. Smith No. 60, 17-section boiler is now being installed. The capacity of this boiler exceeds that of the three boilers previously used. Two of the old boilers have been removed and the third is being reset to bring the water level at the same point as that of the new boiler.

The installation hitherto employed was oil-fired and this system will be continued with the new equipment. The management has found oil burning more economical than coal for the conditions of their business and a 6,000 gallon oil tank is accordingly being installed beneath the boiler room floor. The tank measures 7′ in diameter by 20′ in length.

This same tank will be equipped with a Brown Recording Liquid Level Gauge which will show at all times the amount of fuel in the tank and the rate of consumption.

Other Brown Instruments will be installed including a resistance thermometer. By means of the latter instrument the operating engineer will, by simply turning a switch, be able to tell the exact temperature prevailing in each department of the entire plant without leaving the boiler room. Among boiler operating accessories will be provided a double vacuum pump unit. This unit is practically two pumps on one base, providing a reserve pump for use in emergencies.

The Radiation Pyrometer

Max Hartenheim

IN spite of the fact that the exact knowledge of temperatures is of the utmost importance, either to gain an idea as the efficient use of the heat contained in fuels, i.e., in power plants or where heating furnaces are used, or for the maintenance of a satisfactory uniform product, i.e., in glass plants or in heat treating shops, this branch of practical pyrometry has long received little consideration and is even at present sadly neglected in many plants.

Usually it is considered sufficient to have an indicating or recording pyrometer at the place thought to be most important in the process of manufacture. Seldom, though, is an intelligent ensemble of instruments found, the combined readings of which present a clear picture as to the efficient utilization of the fuel or the proper control of heat, which is required for a high grade product. This condition cannot be wholly attributed to indifference on the part of the operating man—but to a certain degree to the fact that satisfactory, rugged instruments were not available.

The thermo-couple pyrometer has never been entirely satisfactory for higher temperatures. After a short period the thermocouples are destroyed or undergo a change, the indications are incorrect, the operator makes no effort to remedy this condition, but estimates the temperatures by eye.

As long as the technique of pyrometry depended, as in the case of thermo-couples, upon part of the instrument being subjected to the high temperature, installations of this kind unless properly taken care of were unsatisfactory. It was therefore a decided advance that instruments were developed which avoided the necessity for subjecting the instrument to the temperature measured.

The radiation pyrometer is such an instrument. It utilizes the total radiation emitted by a glowing body. These instruments are especially valuable as they increase the range in which temperatures may be indicated and recorded. While the limit for the contact pyrometer is at about 1600°C. (3000°F.) the radiation pyrometer can, theoretically be used up to almost any temperature. Not being exposed directly to the heat, it has a longer life and greater reliability.

The radiation utilizes the total radiation from which the temperature of the hot body may be derived. Every glowing body emits radiant energy consisting, in addition to the visible light rays, of rays beyond the red spectrum, the ultra red or heat rays. The relation between temperature and radiant energy has been the subject of profound research—it was found that for the same temperature almost every body emitted a different amount of energy, dependent upon the surface of the body and on its chemical composition.

The first important step was made by Kirchhoff, who investigated the conditions of absorption and transmission of radiation through

bodies. He found that if all the radiations falling on a body were absorbed by it and none reflected, then the temperature of it would indeed have a definite relation to the energy radiated by it. Such a body, which absorbs all and does not reflect or transmit any part of the radiation is called a black body. In most practical cases, fortunately, a black body is easily realized: the inside of a furnace as well as bodies placed therein form such black bodies, as soon as the pieces have assumed the same temperature as the furnace.

The second important relation, the Stefan-Boltzmann law, fixes the relation between temperature and radiant energy. This law states that the total energy radiated by a black body is proportional to the fourth power of the absolute temperature. It must, of course, be taken into account, that the energy of the body at absolute temperature T is radiated into space, that is, the surrounding space of the body at a temperature To. The law can then be expressed by the equation $E = C (T^4 - To^4)$ in which C represents a constant dependent upon the energy units used. As To is generally small compared with T, and as it appears as the fourth power it may neglected, we therefore have $E = C T^4$ or the energy is directly proportional to the fourth power of the absolute temperature.

In the more recent radiation pyrometers, the radiation from a hot body is concentrated by a lens system onto a small thermo-couple, which is connected to an indicating or recording galvanometer. The wires of the thermo-couple are made very fine, so that the thermal inertia of the system is exceedingly small and variations in temperature are consequently indicated by the galvanometer almost without time lag. This constitutes a decided advantage over thermocouples as usually the protection tube required for the couple has considerable thermal inertia.

The total radiation emitted by the body is collected by the objective lens and focussed on a small thermo-couple. The electromotive force generated in the thermocouple therefore bears a direct relation to the radiation. As stated above the radiation is proportional to the fourth power of the temperature consequently the electromotive force and with it the current in the galvanometer and deflection of the pointer, all are in direct proportion to the fourth power of the temperature to be measured. The temperature scale will therefore not have uniform divisions as is the case with thermocouple pyrometers but have steadily increasing scale divisions.

The telescope is sighted on the glowing body or spot, i.e. an opening in the furnace wall. Practically, the distance from the glowing body is immaterial, provided the small receiving element is completely covered. The area visible through the objective increases with the square of the distance, while the radiation decreases with the square of the distance, the total radiation focussed on the thermo-couple therefore remains the same.

New Instruments

Recently Developed by Instrument Manufacturers

The Standco Model "DM" Megohmer

(Herman H. Sticht & Company)

THE Model "DM" Megohmer is based upon the Voltmeter Method of insulation resistance measurements, but the chief objections to that method have been eliminated by including a self-contained generator and calibrating the scale to read directly in megohms. It embodies a number of features not found in the former Model D Megohmer. The measuring instrument proper and the generator are now mounted in a strong, pressed metal case with a black rubber finish, that is very serviceable.

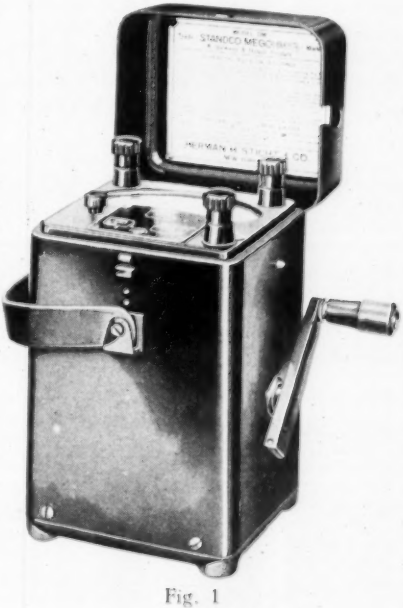


Fig. 1

The Moving Coil. The movement is of high resistance D'Arsonval, or moving coil type, and is dead beat. The double scale permits of using the instrument not only as a direct-reading megohmeter but also as a voltmeter. The knife blade pointer combined with the mirror scale assures a high degree of accuracy.

The whole measuring system is built into a metal housing which is mounted over the generator as shown in Fig. 2. This housing is mounted with shock absorbing springs as shown in the illustration. This is a new feature not heretofore found in measuring instruments of this type.

A test key is provided for checking the generator voltage. This is another exclusive feature of the Standco Megohmers, manufactured by the world renowned firm of Siemens and Halske.

The Generator. The generator, which is hand operated through suit-

able gear reduction, produces 220 to 440 volts direct current. The features of the generator are clearly shown in Fig. 2. The base, on which the generator is mounted, is a die casting with the necessary supports for the magnet, bearings, etc. This not only assures a better assembly with consequent better service but permits of sales prices considerably lower than ever before for instruments of corresponding ranges and quality.

The generator is equipped with carbon brushes instead of wire brushes, as formerly used in instruments of this type.

Crank and Cover. The generator crank is of the folding type and when not in use fits into a recess in the cover of the instrument. The binding posts are mounted so that they are protected when the cover is closed.

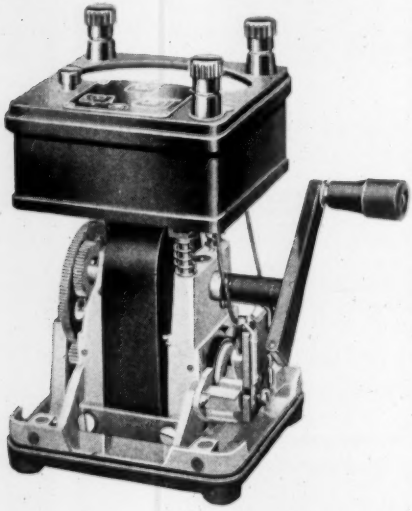


Fig. 2

Full instructions are mounted in the cover of the instrument so that they are always in sight when the instrument is in use.

General. The Model "DM" Megohmer is small and compact. Its dimensions are $4\frac{1}{8} \times 5\frac{1}{8} \times 8$ inches and it weighs $8\frac{3}{4}$ pounds.

The whole instrument has been so designed that its center of gravity is practically at the geometrical center. The instrument does not "wiggle" as is generally the case with light instruments of this type.

Maintenance. The Model "DM" Megohmer has been designed so as to keep the maintenance cost down as low as possible. By removing the screw in the crank handle and the four screws in the case, the housing may be lifted off and the whole generator exposed. This permits of oiling the generator, from time to time with a high grade oil, or cleaning the commutator when necessary. The brush holder is readily removable. All this may be done without disturbing the measuring element that is mounted in a separate sealed housing.

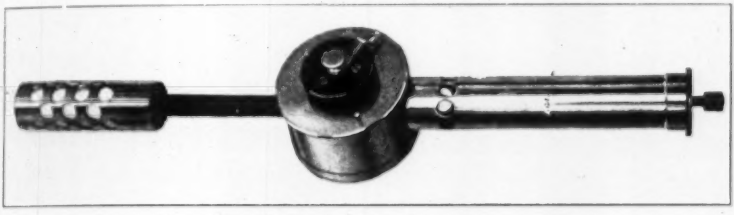
The Model "DM" Megohmer is available in two ranges, 50 and 100 megohms, with 220 and 440 volt generators.

The "Cajo" Gas Leak Indicator

(*Colonial Supply Company*)

THE "Cajo" gas leak indicator is designed to indicate instantaneously the presence of small amounts of light as well as heavy gases mixed with air. Its operation is based on diffusion. The instrument therefore is not intended for the indication of slow changes, but to detect local air changes or differences in concentration.

The chief function of the instrument is to test the tightness of pipe installations, cocks, etc., in a more reliable manner than is possible by the hitherto dangerous method of searching for leaks with a light, or the laborious and troublesome coating of the pipes with a soap solution. The gas leak indicator is further intended to replace the time wasting Palladium-chloride method used for searching networks of mains.



The main part of the "Cajo" leak indicator consists of a porous clay cylinder connected with a diaphragm by means of a small tube. Through the walls of the completely closed cylinder, filled with as well as surrounded by air, a constant interchange of gas from inside to outside, and vice versa, takes place at a uniform rate. If the surrounding gas is lighter than air, the transfusion from outside to inside is faster than the transfusion from inside to outside, and results in a pressure increase in the cylinder. If, on the contrary, the surrounding gas is heavier than air, the transfusion from inside to outside will take place more rapidly than the reverse operation, and a decrease in pressure will then be observed. The pressure differences which take place in the cylinder under the conditions mentioned, act on the diaphragm, the raising or lowering of which opens or closes an electric contact.

For example, if the cylinder comes into contact with light gases, the resultant increase in pressure lifts the diaphragm, closing the contact, lighting a small light. If, on the other hand, the cylinder comes into contact with heavy gases, the circuit is broken and the light extinguished.

The gas leak indicator is adjusted by means of a screw with a knurled handle. When testing for light gases, the contact-screw is turned until the lamp lights, and then turned back just enough to again extinguish the light. A slight movement of the diaphragm, due to the increased pressure caused by the transfusion, is then sufficient to again light the light.

If on the other hand, tests are to be made for heavy gases, the contact screw is adjusted so that the light just lights, so that when a pressure below atmospheric sets in, the movement of the diaphragm breaks the circuit.

The sensitiveness of the instrument can be varied according to the adjustment of the contact screw. The instrument can be set so closely that the carbon dioxide of the human breath will instantaneously extinguish the light.

The current for the lamp is supplied from a flash light battery, which with the lamp is fitted in the handle of the instrument. A second contact screw is provided on the end of the handle to break the circuit when the instrument is not in use. This prevents wasting the battery. As the contact between the membrane and the micro adjusting screw takes place in a gas-tight, completely enclosed housing, there is absolutely no danger of explosions due to sparks.

APPLICATIONS.

Testing of Pipe Installations. The leak indicator will very positively indicate leaks which defy detection when sought with a light, or even by coating with a soap solution.

Testing Networks of Mains. The usual method of doing this is to dig holes certain distances apart in the street, and to insert short pieces of pipe in them, the leaks are ascertained at the upper end by means of palladium-chloride paper. The gas leak indicator offers an immense advantage over the palladium-chloride method, as the pipes are dispensed with. The cylinder of the instrument is just held into the holes in the street. Moreover, the indication is instantaneous, whereas in the case of the palladium-chloride paper tests, the leak can only be determined after a short time.

Testing Combustion Gases in Gas Furnaces. As this instrument reacts with gases heavier than air as well as lighter, the possibilities for its use are very extensive. Leakage of combustion gases from gas furnaces can now be proven with greater ease than with any previous method. The effect of draft disturbances can also be readily ascertained by the use of this indicator. In fact, the "Cajo" gas leak indicator will be found of considerable assistance in the testing of gas consuming apparatus for ascertaining the path of the waste gases.

SUMMARY

The "Cajo" gas leak indicator will detect the escape of all gases, either lighter or heavier than air. Its sensitivity permits the detection of an illuminating gas content in air as low as 0.03%—far below the explosion limit as well as the health endangering point.

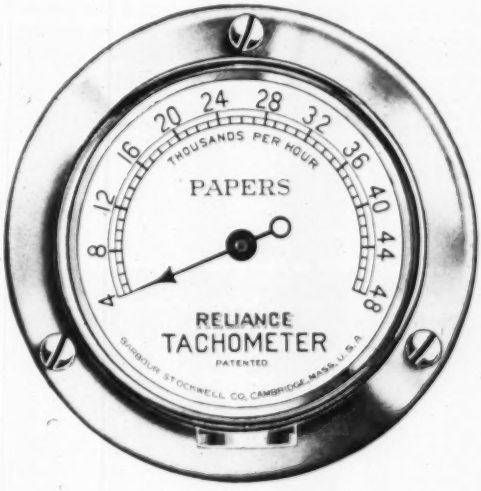
The detection is instantaneous, as soon as the porous cylinder comes into contact with the gases, and the indication is positive. Slowly and gradually increasing concentrations are not shown by this instrument.

Reliance Newspaper Tachometer

(Barbour Stockwell Company)

THE Reliance Tachometer, Model H, has recently been developed especially for newspaper presses. It indicates the accurate production speed in thousands of papers per hour; i.e., the running speed.

The purpose of the instrument is to enable the mechanical superintendent to know his running speed at all times. Given the maximum speed of the press by the builder, the superintendent can determine his efficient running speeds for either color, special or ordinary work. He can arrange his production schedule to correspond with the demands of the mailing room. The instrument head, mounted at the most convenient and legible position, enables every press hand to operate the press more intelligently.



By means of a special adapter, attached (on some presses) to the folder shaft, the instrument head connected by a flexible shafting can be mounted anywhere on the press to assure the easiest reading. Where a folder shaft connection is not desirable, a split gear attachment can be installed on the main drive shaft.

An instrument head has been mounted in the office of the general manager of a large eastern newspaper and operates synchronously with a second instrument, mounted on the press. The shaft running to the manager's office, in this case, is 36 feet; the shaft to the press is 13 feet, running off a dual adapter attached to the main drive shaft. A difference in lengths of flexible shafting from the same adapter does not effect the synchronism of the two instruments whether the adapter is attached to the folder shaft or to the main shaft drive.

This dual outfit enables the general manager to know, without leaving his desk or even telephoning down to the press room, when the press starts, when it stops and how fast it is running at any moment. Should the press break down or stop for any reason during the regular time for running, the manager knows it immediately since the indicator will register zero.

For high speed presses, the dial is graduated from 4 to 48 thousands

per hour; for low speeds, 3 to 36 thousand per hour. Instruments for indicating higher speeds are also available.

The outfit, finished in nickel-plate, is guaranteed for 3000 hours constant use. Research is under way to adapt this instrument to other fields where there is a need for such a productometer.

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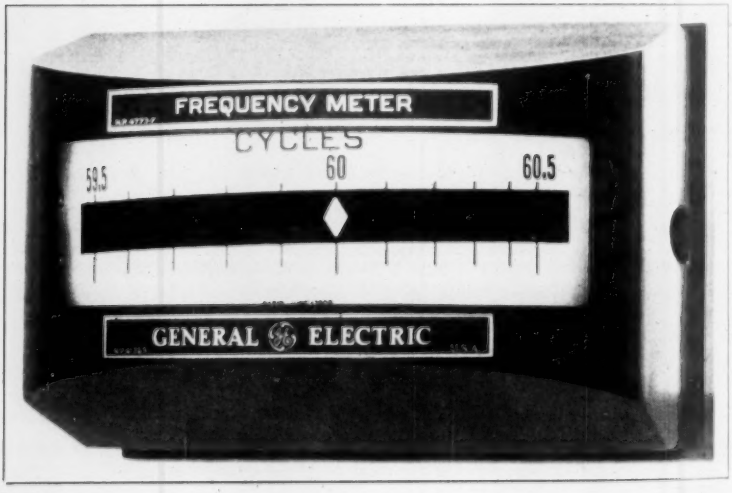
New Frequency Meter

(General Electric Company)

IN response to the requirements for a more accurate frequency meter for central station work, a new line, of resonant-circuit type instruments in which full scale range may be as small as a single cycle, has been developed. The new meters are of horizontal edgewise design, long found to be most satisfactory for this class of device, and are known as Type H-8 frequency meters.

The line includes five scale calibrations, the most sensitive having a full scale range between 59.5 and 60.5 cycles. Other calibrations are for 2, 5, and 10 cycles, arranged for service on 25, 50 and 60 cycle systems. All are intended for 110-volt operation.

In the design of these meters accuracy has been held of main importance. There are not appreciable voltage, wave form or temperature errors, even when operated under extreme conditions. The resonant circuit principle gives a defecting torque which is proportional to the difference in the squares of the currents in two resonant circuits, and thus makes possible large deflections for very small changes in frequency. A further point of accuracy is obtained by the horizontal edgewise arrangement, in that parrallax between needle and scale is eliminated, permitting extremely close readings regardless of the angle from which the meter is observed.



The Beck Pathological Microscope

(R. & J. Beck, Ltd.)

THIS microscope has several new and important features. The stage is of the built-in mechanical model where the entire top plate is moved both in the horizontal and vertical directions and can be cleared of all obstructions so that a culture plate or petri dish can be placed upon it and moved by means of the mechanical stage.

The substage is on an entirely new design, and the apparatus used in it is interchanged by means of dovetailed slides. Now that dark ground illumination is practically a necessity in many branches of microscopy, it is frequently necessary to change rapidly from one form of illumination to another. The method adopted in the "Pathological" microscope enables this change to be made rapidly and with the minimum disturbance of the adjustments of the instrument. The precision with which the substage apparatus takes its position is much greater, and a properly fitted dovetailed slide with an efficient clamping screw is a most accurate method of positioning a fitting.

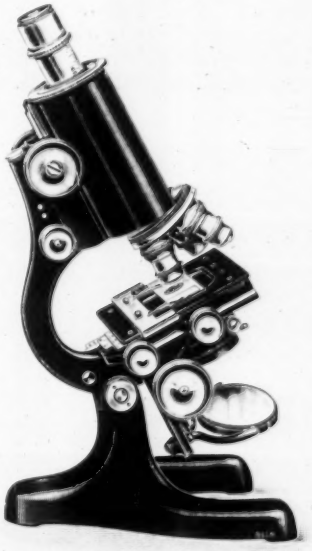


Fig. 1

The following gives a brief specification of the instrument:—

The Base and Pillar are of one heavy casting having a spread of 5½ in. by 7¼ in. The pillar has a joint for inclination of the limb, which has stops for the vertical and horizontal positions.

The Stage is of the built-in mechanical model, where the whole top plate travels. It has a movement of 1 in. in the vertical direction and 1½ in. in the horizontal. It is operated by two milled drums at the side of the instrument which do not project above the level of the top of the stage, so that very large flat objects can be placed upon the stage without obstruction. A sliding ledge can be fitted to the stage if desired. For holding the 3 in. by 1 in. slip, stage clips are provided, also a top stage can be supplied, which positions slides upon the stage where it is required to do so in conjunction with the verniers which can be fitted to the mechanical stage. The whole mechanical stage is of a particularly robust construction, and the mechanical motions give smooth and easy movements free from backlash.

The milled heads which operate the mechanical stage and the substage are placed upon the left hand side, so that they do not form an obstruction when the instrument is used for drawing with a Camera Lucida.

The Limb is of a solid curved pattern, shaped for grasping with the hand for lifting the instrument.

The Body is of a large size, 2 in. in diameter, and carries an adjustable drawtube which is divided in millimeters, enabling any tube length from 140m/m to 200 m/m to be used. The lower end of the drawtube has a standard R. M. S. thread to carry an erecting lens or a very low power objective glass if desired.

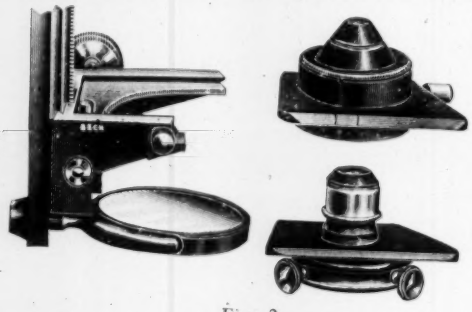


Fig. 2

The Coarse Adjustment is by means of spiral rack and pinion cut on specially made machines to ensure an accurate and smooth movement. The milled heads are 1½ in. diameter.

The Fine Adjustment is on a patented design and is operated by two milled drums, one on each side of the limb. The milled head on one side moves the body at twice the speed on that on the other, so that a moderately fine for low powers, or a superlatively fine adjustment for high powers can be used.

The Substage employs dovetailed slides, the principle of which can be seen from the illustration, Fig. 2. Each piece of apparatus is fitted to a slide with a projection for holding, which is slid into the dovetail in the substage itself and clamped in position by a screw with milled head. By this system the changing is easy and certain, as the slide is forced up against one side of the dovetail, and must therefore take up its correct position. The substage is focussed by rack and pinion.

The Mirror is double, plane and concave, and of 2 in. diameter.

The instrument is packed into a polished mahogany cabinet with carrying handle.

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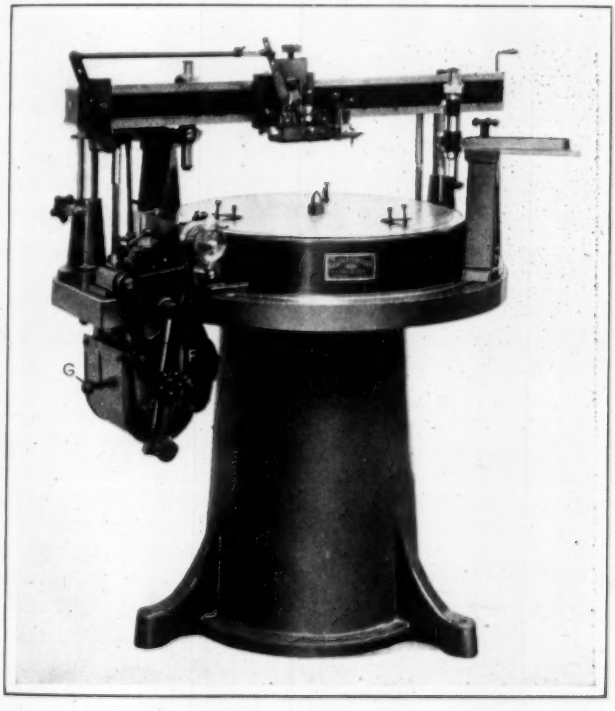
To help you find any instrument easily and quickly, refer to the Buyers' Guide contained in the back of this book. Turn to it now and see how wide the variety of instruments it offers. Remember to consult the Instruments' Buyers' Guide when in the market for instruments.

New Circular Dividing Machine

(Gaertner Scientific Corporation)

LINES may be accurately ruled around circles up to 25 inches in diameter by means of this new precision circular dividing machine. Almost 65,000 spacings can be obtained. At maximum speed, the machine rules lines at a rate of 48 per minute. Lines of various lengths and in different combinations can be produced on flat, beveled or vertical surfaces. The machine is designed for either laboratory or shop and for automatic operation. Accuracy within plus or minus 1 second of arc is guaranteed.

The table of the machine consists of the machined side of a worm-wheel 24 inches in diameter and having 360 teeth. This combination table and worm-wheel is mounted on a tapered seat of a spindle in the center of the machine. The weight of the worm-wheel, spindle, and work is relieved by a spring at the lower end of the spindle, and the thrust is taken up by a hardened steel ball. To insure uniform accuracy of the machine, it is important, that the spring be adjusted



according to the weight of the worm-wheel. Such adjustments are

conveniently made by turning a screw. Oiling of the spindle is easily accomplished.

Eighteen concentric grooves are cut in the table face of the worm-wheel to assist in centering objects, while 54 holes are tapped in this face to facilitate clamping the objects in place. Near the periphery of the worm-wheel, there is an inlaid silver strip that is graduated in 1/6 degrees, every second degree being numbered. The strip is sufficiently wide to receive any other graduations which may be irregularly spaced and copied by making settings with the microscopes.

The thread of the worm, which drives the combined table and worm-wheel is accurately corrected for periodical and progressive errors by means of a special apparatus. Small inaccuracies in the worm-wheel are compensated for by automatically shifting the worm back and forth along its axis, which is accomplished through a thrust screw.

The rotation of the worm is accomplished by means of a ratchet and spur gears which are driven by a gear sector. Oscillating motion is imparted to this gear sector by an adjustable crank lever that is mounted on a shaft, together with an eccentric which operates the tracing mechanism. This shaft is rotated by worm-gearing which is driven by a three-step cone pulley, which is driven by a 1/4 inch round belt that is connected to a 1/8-horsepower motor running at a speed of 1200 R.P.M. The main-drive worm-gearing and the eccentric for operating the tracing mechanism are protected by a steel casing that is provided with oil reservoirs for lubricating the parts. In starting the machine, handle G is lifted to engage worm and wheel.

An automatic stop mechanism provides for stopping the machine precisely when any desired number of lines from 1 to 10,000 has been ruled.

The tracing mechanism is operated by a lever, which is connected through a rod to the bell crank lever seen at the left-hand end of the machine in the figure. The tracing mechanism permits the ruling of lines up to about 1 inch long. The lever actuates a spur gear through a friction clutch that is adjustable. This adjustment provides for cutting heavier or lighter lines.

The entire tracing mechanism is mounted on a vertical slide which may be adjusted about 1 inch. The entire unit can also be set an angle from horizontal to vertical so as to permit the graduating of inclined, flat or vertical surfaces. The tracing mechanism is mounted on a cross beam and can be clamped at any point along the beam. The height of the beam above the combined table and worm-wheel may be varied by turning a crank handle to actuate two elevating screws. The maximum distance between the dividing tool and the top of the worm-wheel is 5½ inches. Two microscopes which are mounted on adjustable brackets, as shown, are supplied. The weight of the machine is approximately 720 pounds.

Microid Adaptable Galvanometer

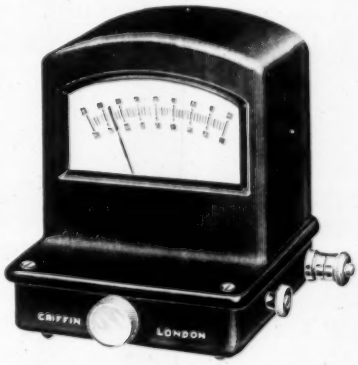
(John J. Griffen & Sons, Ltd.)

THIS instrument has been designed to meet most requirements in general laboratory practice. It is capable of adaptation to a great variety of purposes, for which ordinarily several separate instruments would be needed. Its construction being simple and effective, its cost is remarkably low.

It is made in two types—The Universal and The Sensitive. Both are fitted with a pointer, and may be supplied with or without a mirror. The Universal Models can be used in both vertical and horizontal positions.

THE MICROID ADAPTABLE GALVANOMETER— UNIVERSAL MODEL

The Moving System is of the taut suspended D'Arsonval type and may be supplied either ballistic, or, if so ordered, critically damped. The system may be securely clamped by a half-turn of a knurled head at the side of the case. The standard resistance is about 50 ohms, but systems of about 10 or 375 ohms may be supplied, if so ordered, at the same prices.

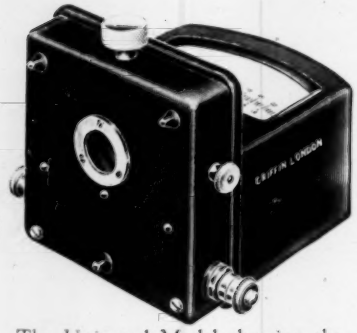


The Universal Model in vertical position.

The Universal Model in horizontal position.

The Scale is about 5 cm. long and has 100 equal divisions with a centre zero. The pointer is adjustable by a knurled head on the top of the case and is provided with two stops.

The Case, measuring 3½x3½x 4½ in., is of aluminum, finished in frosted black with nickelled fittings. It consists of a back plate, on which the whole of the working parts are carried, and a cover, which is secured by four easily removable screws. On removing the



The Universal Model showing the Mirror.

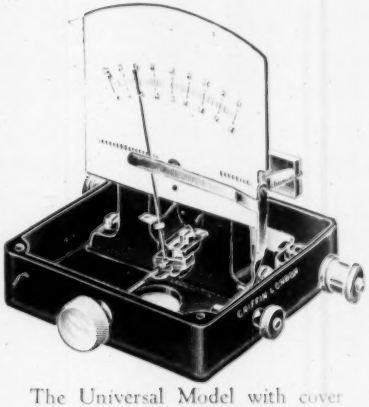
cover, every part of the system is immediately accessible.

The Universal Model is robust and has a sensitivity amply sufficient for general purposes, for which it is recommended also on account of its great adaptability.

The Mirror is carried on the back of the coil opposite a window in the back plate. It is supplied for one metre scale distance unless specially ordered otherwise.

THE MICROID ADAPTABLE GALVANOMETER— SENSITIVE MODEL

This Model is intended for those requiring an instrument of special sensitivity. It differs in construction from the Universal Model only in having a single suspension with silver lead-in spiral to the bottom of the coil in place of a taut suspension. It is not intended for use in a vertical position.



The Universal Model with cover removed.

Both the Universal and Sensitive Models may be supplied without mirror, and all Models are supplied of about 50 ohms with ballastic system, except ordered to be 10 or 375 ohms or with a critically damped (dead-beat) system.

The chief advantage of the Microid Adaptable Galvanometer is in its combination of sensitivity with adaptability. It is a robust instrument which does not require special care in handling. It is made on high-grade lines, and its low price arises only from the simplicity of its design and the methods used in its manufacture. On removing the cover, all its parts are accessible.

Back Issues Not Available

REQUESTS are received daily for back issues of INSTRUMENTS and we are sorry that it is not possible for us to comply with these requests.

In answer to our appeals for the return of copies of this issue we have to-date received so few copies that there are still over three hundred requests we cannot fill.

A New Brinell Microscope

(Paul F. Hermann Co.)

THE ever increasing use of the Brinell-Hardness test in industry has made it necessary to perfect the existing lens and measuring microscope devices, which are essentially adapted to laboratory use; or even to replace them by another instrument, which would afford in the hands of both employer and operator absolutely trustworthy measurements of at least the same degree of accuracy.

This is particularly important for those plants in which the guarantee of a definite degree of Brinell-Hardness is required in the specifications of parts (such as springs, steel castings, etc.).

The carrying out of such measurements can, if done with the lens and measuring microscope, only be entrusted to those skilled in taking these measurements. The lens and measuring microscope require especially good illumination of the work that is to be measured which may not always be possible, on account of the position, shape and form of the object. There is also additional the serious disadvantage to be considered that, in this method of reading, the eye tires rapidly owing to the double focussing required on the scale and on the object. Thus the accuracy of the readings is often questionable on account of fatigue, especially when a large number of measurements must be carried out in succession.

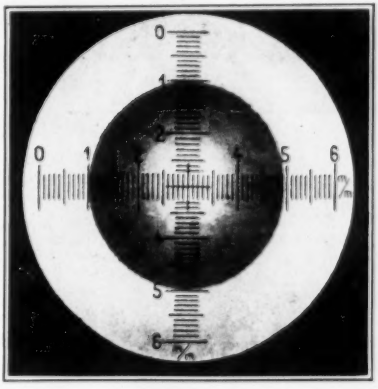


Fig. 1.

With the Busch-Schumann Projector, however, the image of the Brinell-Ball-Impression, even when a lipped rim is produced, appears at once, magnified ten times and sharply focussed on a ground-glass screen as soon as the instrument is set up in the spot to be measured; so that the measurement can be read immediately and without trouble, with both eyes and with great accuracy; moreover the result, unlike that obtained with lens and measuring microscope appears with even edges and without any focussing.

With the light falling always perpendicular to the measured surface, the edge of the crater, unlike that produced with lens and microscope, is always revealed with equal sharpness of definition, even when the rim bulges, as the photograph of the ground-glass plate (Fig. 1) shows.

In consequence of the small size of the instrument, the measurement and testing of materials is now possible in places which are difficult to access, where formerly readings with lens and measuring microscope were either difficult or had to be abandoned on account of the poor lighting. This type of measuring instrument altogether new, fulfills thoroughly all expectations and requirements, as has been proved by experience in numerous factories. Its manipulation is extraordinarily simple, as shown in Fig. 2. It is about 12″ long. The projector with its interchangeable lower part is set up on the surface to be measured. The illuminator, which is incorporated in the instrument, lights up the surface so intensely, that the image is projected with very great clearness through the built-in objective on to the ground-glass screen arranged above it, on which then two diameters of the Brinell-impression can easily be read at once with an accuracy of 1/320 in. or greater with the help of the cross-scales on the ground glass. The ground-glass with scale can also be rotated, so that now both diameters can be read quickly for any desired setting.

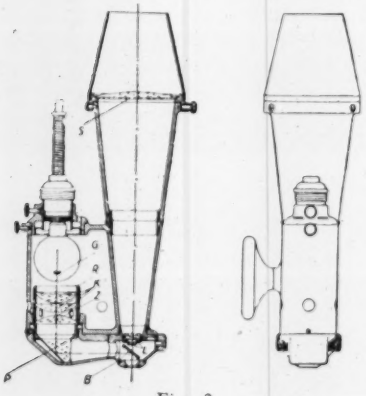


Fig. 2

Measurement of this kind is carried out with extraordinary speed when compared with the former method and is at least of equal accuracy. Fig. 1 shows the ground-glass slide in its natural size up to 2½″ diameter, i.e. it is suitable for measuring crater-diameters of ¼ in. or 6 mm.

With a special device Brinell-Ball-Impressions may also be obtained of recessed surfaces or surfaces which are not plane. Also the upper part of the tube is interchangeable with an angle-piece carrying a vertical ground-glass slide. This enables one without further adaptation to take satisfactory Brinell-tests also on the inner walls of hollow cylinders, with a minimum internal diameter of 8¾ in. or to make measurements in which readings on a vertical ground-glass slide are desired.

In special cases the ground-glass images may be recorded photographically by the insertion of a photographic plate (size 3½″ x 2½″); the necessary accessories for this purpose are supplied separately.

The projector, furthermore, can be used for forgery examination of paper money and signatures. Also for the examination of paper and fabric products (counting of threads). The projector finally is suitable for the use in watch industry, for medical purposes, etc.

Meriam Indicating Flow Meter

THE Meriam Company has now placed on the market a new type of indicating flow meter suitable for measuring the flow of air, gas, saturated or superheated steam; oils and other liquids at any temperature, vacuum or pressure.

Primarily the meters are designed for high line pressures—1000 lbs. per square inch or even higher, but with slight modifications they may be used with equally satisfactory results on vacuum or on low pressures. Their operation depends upon the fact that the flow of the liquid or gas causes a loss of pressure along the pipe. To insure correct readings, an accurately-proportioned orifice-disc is placed in the path of the flow in the pipe and two small tubes are cemented to the pipe line, one on each side of the orifice disc. The difference in pressure between the two sides is recorded by the level of mercury, or other non-evaporating liquid of constant weight. Since there are no gears, springs, etc., it is evident that the meter gives unusually accurate results over long periods. The orifice-disc, being made of Monel metal, will not wear or corrode. It is obvious that the scale may be calibrated in cubic feet, barrels, pounds, gallons, or other quantities per hour if desired.

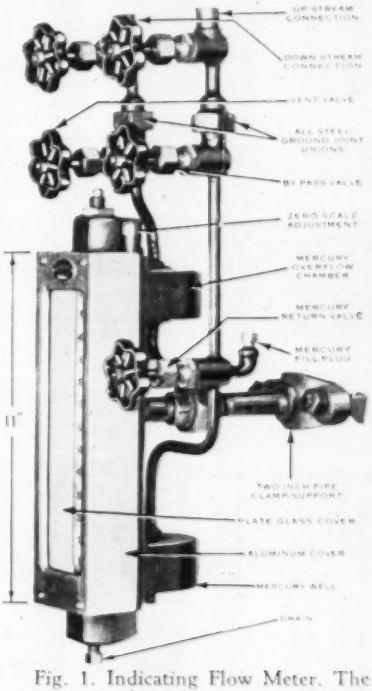


Fig. 1. Indicating Flow Meter. The pipes and valves shown are welded together by the new atomic hydrogen process to assure perfect strength and freedom from leakage under heavy pressures.

The construction of these meters presented some interesting features. In view of the very high pressures which must be dealt with in many cases, and to the inaccuracy which would be caused in the readings by even the smallest leakage under such circumstances, it was decided to weld all pipe-lines, valves, etc., in the meter connection instead of using threaded unions. After considerable experimenting with various types of welding, the new atomic hydrogen welding was used; and this method, it is stated, not only makes a perfectly solid and non porous weld but also requires no extra grinding or finishing to give a clean finish.

The atomic welding method combines the advantages of both the gas and arc welding systems, but the heat—and consequently the speed and ease of operation—is considerably in excess of either of the other systems.

The welding "torch" consists of a pair of adjustable tungsten electrodes between which the electric arc is maintained, and a tube and valve communicating with a cylinder of compressed hydrogen. The hydrogen is directed over the electrodes on to the work, thus covering the molten area of the work with an envelope of non-oxidizing gas and avoiding the usual "scaling" which takes place when metals are highly heated. This assures homogeneous welds.

Fig. 2. Welding the pipe-work of a Meriam indicating flow meter by the new atomic hydrogen process.

Another important advantage of the atomic welding process is the very high heat produced. The hydrogen is split up into atoms and the energy thus freed creates a temperature which is stated to be as high as 8000 degrees Fahrenheit—the highest heat ever produced by artificial means.

Instruments Book Shelf

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HOROLOGY—THE SCIENCE OF TIME MEASUREMENT AND THE CONSTRUCTION OF CLOCKS, WATCHES AND CHRONOMETERS. *J. Eric Haswell.* Chapman & Hall, Ltd., 1928. Cloth, 267 pages.

REVIEWED BY M. BERG RIMBACH

This book is a very valuable addition to scientific literature in this field. The fundamental principles of time measurement are taken up as well as calculations for finding the lengths of pendulums, numbers for wheels and pinions. Various forms of escapements, striking and chiming mechanisms, repeating and chronograph work, balances and springs, keyless devices, electric clock systems and marine chronometer are illustrated and described.

The book presents the information in such a manner as to assist the student and provide a work of reference for the more experienced.

A.S.S.T. HANDBOOK 1929 EDITION. American Society for Steel Treating, Cleveland, Ohio, 1928. Cloth, 669 pages, $7.50.

REVIEWED BY M. BERG RIMBACH

The A.S.S.T. Handbook, which has been published in loose-leaf form for almost five years, is now issued in bound form. The information has undergone slight revisions.

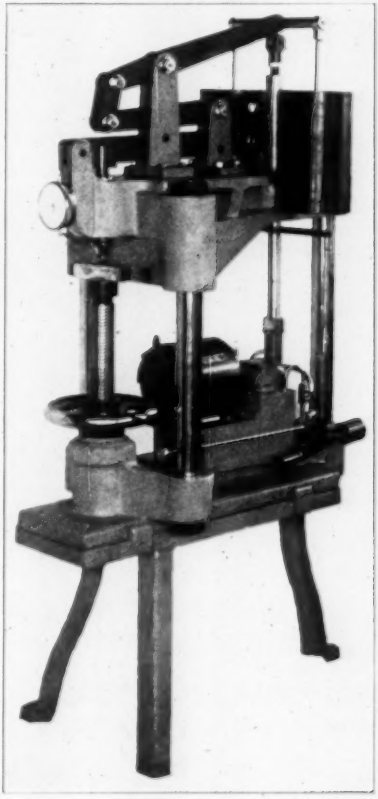
(Continued on Page 462)

New Precision Hardness Testing Machine—Brinell Type

(Pittsburgh Instrument and Machine Company)

THE Precision Hardness Testing Machine was designed to produce an accurate instrument that could be operated by power and produce consistent results. The accuracy of the Brinell hardness test is governed by the accuracy of the applied load, the rate of application of the load, and the time the full load is applied.

A system of weights and levers is the most accurate device for applying a fixed load. This method is used in the construction of balances and other accurate weighing and testing machines. The precision hardness testing machine utilizes a system of weights and levers to give the applied load.



The effect of the rate of application of the load, in making a Brinell hardness test, was thoroughly investigated by the Hardness Testing Committee of the A.S.S.T. They found: that if the load is applied rapidly, the depression will be greater than if it is applied slowly and gradually, that the results obtained when testing soft steel were more irregular than those obtained when testing medium hard and hard steels, and that the time required to reach a point of equilibrium beyond which there is only a slight change in the depth of depression is longer for soft steel than for hard steel. They also found eight seconds to be a satisfactory time to apply the load. The precision hardness testing machine applies the load gradually in eight seconds.

The Hardness Testing Committee also investigated the effect of the length of time the full load was applied. They found that there was a constant increase in depression diameters from five to

eighty seconds. Beyond thirty seconds there was a slight flow of metal, but the amount was so small that thirty seconds was recommended as a standard time to conduct a test. The precision hardness testing machine is adjusted to apply the fixed load in thirty seconds.

On routine testing it is often necessary to sacrifice accuracy for speed. The precision machine can be quickly adjusted to give any rate of application and any time of full load applicaation. Once adjusted, the rate and time will always be constant and the error will always be constant.

All of the present Brinell machines possess one or more of the following defects: They do not exert an accurate load, but are subject to overloading and unloading. They have no means of controlling the rate of load application. They have no means of controlling the time the full load is applied.

The accuracy of the results obtained with the present machines is dependent upon the design of the machine and the care and the skill of the operator.

The precision hardness testing machine overcomes the above defects and removes the personal equation in making the tests.

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(Continued from Page 460)

DIE TECHNIK ELEKTRISCHER MESSGERAETE. *Georg Keinath.* R. Oldenbourg, Germany, 1928, 3rd completely revised edition.

VOL. I: MEASURING INSTRUMENTS AND ACCESSORIES. Cloth, 620 pages. Price Postpaid $10.00.

VOL. I: MEASURING METHODS. Cloth, 424 pages. Price Postpaid $7.00.

VOLS. I & II Together Postpaid $15.00.

REVIEWED BY MAX HARTENHEIM

Contents Vol. I: General qualities of electrical measuring instruments—materials for electrical measuring instruments—description of the measuring part—recording instruments—accessories for instruments—index.

Vol. II: Measurement of voltage—of current—of power—of power factor—of frequency—synchronizing instruments—remote measurements—measurement of resistances—of capacities—of inductances—of velocities—of time—of path and distance—of acceleration—of pressure—magnetic measurements—Appendix 1: Rules for valuation and testing of measuring instruments; 2: Rules for valuation and testing instrument transformers—index.

The contents given above already are a perfect indication of the completeness of these volumes which furnishes any desired information to the designer and manufacturer as well as to the consumer. The calculation of the moving forces, the sensitivity required for given cases, the mechanical strength of the instrument as a whole are fully discussed and illustrated in numerous examples of instruments of different makes. The principles of measuring methods in the second volume include also all the most recent additions as klydonograph, cathode-ray oscillograph etc. The whole material is treated with the simplest use of mathematics and arranged in such way that any desired special information can be found in a short time. Especially valuable is the appendix with the rules which give the standards of different countries in cases where so far no international standard has been agreed upon.

In all, these two books, although written in German, are not only for German readers, but for any one a never failing source of information on any subject related to the measurement of any physical quantity. The reviewer was, however, astonished not to find, among the magnetic measuring methods, the well-known hysteresis meter of Ewing once used so widely for the testing of iron sheets.

ELEKTRISCHE TEMPERATUR-MESSGERAETE. *Georg Keinath.* R. Oldenbourg, 1923. Cloth, 275 pages, $4.00 postpaid.

FEUCHTIGKEITSMESSUNG. *Herman Bongards.* R. Oldenbourg, 1926. Cloth, 322 pages, $5.00 postpaid.

DEHNUNGSMESSUNG AM LAUFENDEN RIEMEN. *Georg Steinmetz.* R. Oldenbourg, 1917. Paper, 20 pages, 50c postpaid.

(Continued on Page 7)

The New Unimeter

(*O. C. Rudolph*)

A POLARIZATION photometer of the Martens type constitutes that part of the Unimeter, by which the various photometric measurements are made. The polarization photometer itself contains a twin prism which produces the two part field of view, and a polarization prism according to Wollaston, the latter causing polarization of the two comparison light beams in vertical orientation to each other. The two light pencils then pass through a Nicol prism and by turning the latter about the optical axis, the light pencils become brighter or darker according to the law of polarization. The Nicol prism is turned to a position at which equality of illumination of the two image halves is obtained. The angular degree of the turning is read from a divided

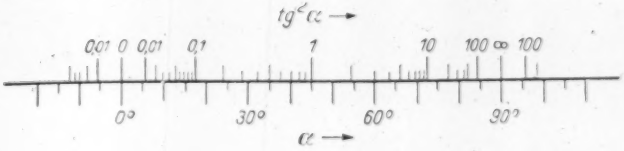

Fig. 1.

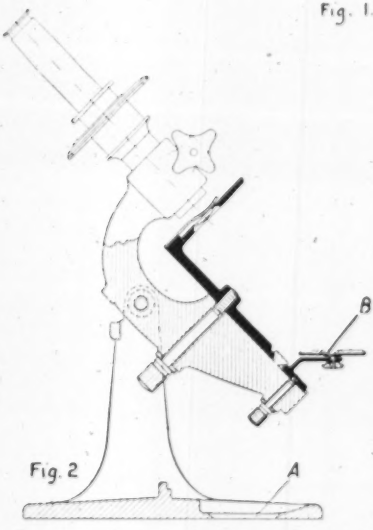

Fig. 2

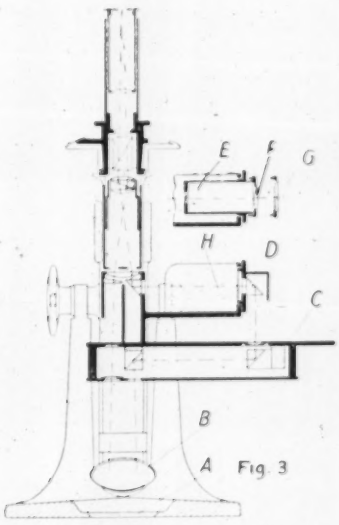

Fig. 3

circle. The proportional light value is obtained by calculating the square of the tangent of the angular degree reading. In order to simplify the use of the photometer, the divided circle of the Unimeter is further provided with a scale for the tangent square within the range of the first quadrant of the degree scale 0—90° extending on either side by 10°, see figure 1. By this means the proportional light value can be read directly from the scale. As may be seen from the figure 1, measurements can be taken with good accuracy within the higher

range of the division, i.e. from 0·1—1 and especially within the lower decade between 0.01—1 which covers almost 1/3 of the range from 0—1.

Above the divided circle of the photometer is the ocular to which is attached a revolving disc with one open aperture and three apertures containing colored glasses, i.e. red, green and blue.

For measuring reflection, the Unimeter can be placed on the sample which serves as a measuring and comparison surface. For this purpose the foot of the Unimeter is provided with a cutout (A figure 2 & 3) also a detachable plate of magnesia (B) or an opal glass plate covered with magnesia oxide can be used as a comparison field. From the comparison field the light passes through a lens into the polarization photometer. For other measuring methods a special stage for the specimen (C figure 3) is attached to the instrument. One beam passes directly into the photometer and the other is reflected four times by a set of prisms before entering the photometer. In this case the specimen under examination is placed into the path of light between the second and third prism (figure 3) for measuring transmission or absorption. Further, the prism (D) can be interchanged with a special small tube (E) to which is attachable a lens (F) or an opal glass plate (G). By means of lens (F) the image of a specimen under examination, placed lateral to the instrument, is projected into the photometer. Opal glass plate (G) serves for illumination measurements. The instrument can be inclined about the horizontal axis and clamped in any desired position for more convenient observation.

Measurements can be made by daylight or in a dark room; in the latter case no special illumination device is necessary; any ordinary table lamp with a low projecting reflector will serve the purpose. Changes in intensity of the daylight or in artificial light used for illumination, have no effect on the reading results. However, distinction must be made, whether the specimen is colorless or colored. For colorless material the free aperture in the revolving disc above the eye piece is used. Colored samples are measured successively with the red, green and blue colored glasses, in accordance with the three color method. However, other color filters may be used to suit special requirements.

The Unimeter can be used to great advantage for the accurate measurement of:

(a) Light transmitted or absorbed by clear material like glass, solutions etc. of small or large dimensions.

(b) Material of turbid nature as for instance opal glass, photographic plates, etc.

(c) The transparency of paper, especially tracing paper and printing paper, and other similar material.

(d) The surface deflection of diffuse or polarized light from paper, paints, silks and other woven material.

(e) Illumination and intensity of light sources.

THE MODERN CALORIMETER. *Walter P. White.* Chemical Catalogue Company, New York, N. Y., 1928. Cloth, 194 pages, $4.00.
Review by Arthur Schroder on page 9 of the July issue of INSTRUMENTS.

MEASUREMENT OF AIR FLOW. *E. Ower.* Chapman & Hall, Ltd., 1928. Cloth, 199 pages, $5.00.
Review by M. Berg Rimbach on page 11 of August issue of INSTRUMENTS.

THE MICROSCOPE. A SIMPLE HANDBOOK. *Conrad Beck.* R. & J. Beck, Ltd., 1923. Cloth, 144 pages.

THE MICROSCOPE. AN ADVANCED HANDBOOK. *Conrad Beck.* R. & J. Beck, Ltd., 1924. Cloth, 231 pages.

DIE GRUNDLAGEN DER DAMPFMESSUNG NACH DEM DIFFERENZDRUCK-PRINZIP. *W. E. Germer.* R. Oldenbourg, 1927. Paper, 60 pages, 80c postpaid.

ANLEITUNG ZU GENAUEN TECHNISCHEN TEMPERATURMESSUNGEN. *O. Knoblauch and K. Hencky.* R. Oldenbourg, 1926. Cloth, 174 pages, $4.00 postpaid.

MATERIALPRUEFUNG UND BAUSTOFFKUNDE FUER DEN MASCHINENBAU. *W. Miller.* R. Oldenbourg, 1924. Cloth, 370 pages, $4.00 postpaid.

"Cooperation is not a sentiment—it is an economic necessity."—Charles Steinmetz.

NEW INSTRUMENT INFORMATION FORM

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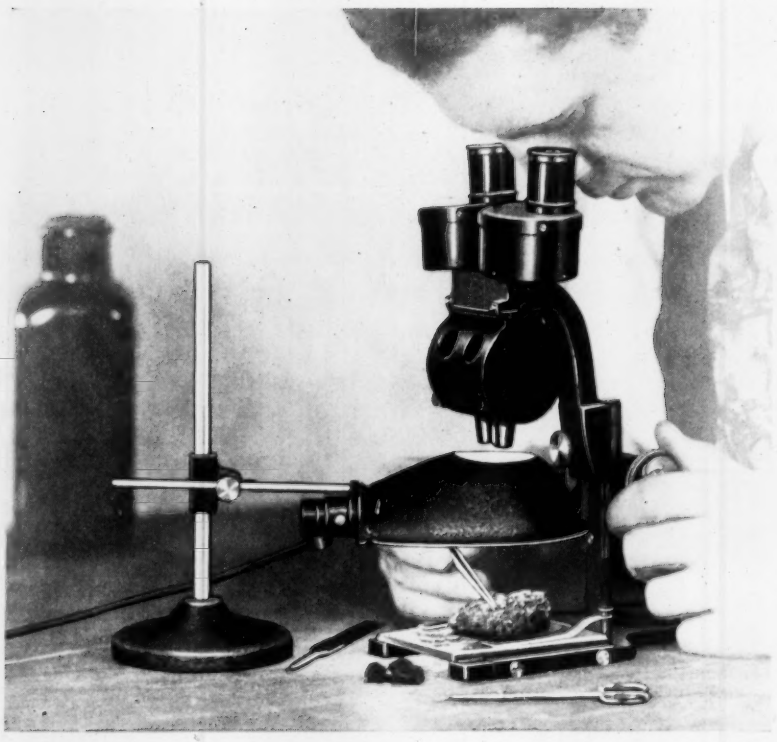

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Aviation Instruments

The Taylor Instrument Companies, Rochester, N. Y., have just issued a very interesting bulletin on instruments for aviation. In addition to instruments for the plane itself, instruments for the Airport are also taken up.

Bausch & Lomb Magazine

The September issue of this publication, issued by the Bausch & Lomb Company, Rochester, N. Y., contains the following articles: All Rochester Observes the Anniversary of Bausch & Lomb. "Style" Wins in Extra Pair Contest.

Bristol's Instruments

A very interesting direct mail letter recently sent out by the Bristol Company, Waterbury, Conn., covers their temperature controllers.

Flow Meters and their Uses

Bulletin No. 680 of the Cochrane Corporation, 17 St. and Allegheny Ave., Philadelphia, Pa., covers the flow meters manufactured by them.

Instrument Investment News

The September issue of the Instrument Investment News issued by American Schaeffer & Budenberg Corp., 338 Berry St., Brooklyn, N. Y., has many interesting articles.

Portable Meters

Bulletin 502, Rawson Electrical Instrument Co., Cambridge, Mass., covers the Rawson Single and Double Pivot, High Sensitivity Meters, Thermo Junctions in Vacuo, etc.

Radiation Pyrometers

Bulletin No. 11 of the Thring Instrument Company, 3339 Lancaster Ave., Philadelphia, Pa., has just been published.

Successful Operation the Keynote

Bulletin 328 issued by the Esterline-Angus Company, Indianapolis, Ind., is an intimate description of the procedure in the Esterline-Angus plant, to insure that every instrument, if possible, renders satisfactorily the service for which it is purchased.

American Electric Furnaces

A recent catalogue brought out by the American Metallurgical Corporation, Boston, Mass., covers the various furnaces manufactured by them.

Baking Instruments

Catalog Part 900-B of the Taylor Instrument Companies, Rochester, N. Y., lists, illustrates and describes the various instruments manufactured by them for the baking industry.

Bi-Colorimeter

Pamphlet No. 1058 issued by E. Leitz, Inc., 60 East 10 St., New York, N. Y., covers the construction, instructions for use, and applications of the Prof. Myers Bi-Colorimeter—"Model D."

Canning, Packing and Preserving Instruments

Catalog Part 500 recently issued by Taylor Instrument Companies, Rochester, N. Y., cover the Tycos Instruments for use in canning, packing and preserving.

Carboscope

A. Gallenkamp & Co., Ltd., 19 Sun Street, Finsbury Square, London, E.C.2, England, have issued circular No. 268 covering their float and sink apparatus for testing small coal.

Colorimeter

The Buerker Colorimeter is described and illustrated in List Mikro E2186 issued by E. Leitz, Inc., 60 East 10 St., New York, N. Y.

Experimenter

The September 1928 issue of the Experimenter, published by the General Radio Co., Cambridge, Mass., contains the following articles: Notes on Group Address Systems; Type 426 A Thermionic Voltmeter; Station Frequency Meter Type 532; A new Amateur Condenser; Mutual Conductance Meter Type 443.

Gas Plant Instruments

Catalog Part 600 of the Taylor Instrument Companies, Rochester, N. Y., lists and illustrates their instruments for Gas Plants.

Gas Service Journal

The August 1928 issue of the Gas Service Journal published by the Pittsburgh Equitable Meter Co., Pittsburgh, Pa., contains the following articles: Meter Department Tests, Repairs and Supplies, All Types and Sizes of Meters for Gas Service; Liquid Gas Fuels and their Properties at Low Temperatures; A real Gas Operating Feat.

Hydrometers

Industrial Hydrometers are covered in Catalog Part 1500 issued by the Taylor Instrument Companies, Rochester, N. Y.

Hygrometers

Hygrometers (Wet and Dry Bulb Thermometers) are covered by Catalog Part 1300 issued by the Taylor Instrument Companies, Rochester, N. Y.

Hardness Testing Hammer

Steel City Testing Laboratory, 5444 14th Ave., Detroit, Mich., describes their Type P Hardness Testing Hammer.

Heat Flow Meter

A Heat Flow Meter for determining the heat lost through pipe insulation is covered in a recent leaflet issued by Trost Brothers, 104 Victoria Street, London, S.W.1., England.

Lumber Dry Kiln Instruments

The applications of Tycos Instruments to Lumber Dry Kilns are shown in Catalog Part Five issued by the Taylor Instrument Companies, Rochester, N. Y.

Measurement of Temperatures in Boiler Furnaces

The Pyrometer Instrument Company, 50 Howard St., New York, N. Y., has available for distribution a reprint from the August issue of Instruments "Measurement of Temperatures in Boiler Furnaces."

Measuring Gage-Blocks by Light Waves

Is the title of a reprint from the July issue of Machinery distributed by George Scherr Co., 142 Liberty St., New York, N. Y.

Microid Adaptable Galvanometer

Leaflet 18X issued by John J. Griffen & Sons, Ltd., Kemble St., Kingsway, London, W.C.2, England, describes their new Microid adaptable Galvanometer.

Microscopic Inspection of Materials

Literature A.W. 4, 28, 2500 issued by Schuchardt & Schuette, 142 Liberty Street, New York, N. Y., is a concise treatise on the Microscopic Inspection of Materials.

Micro-Manipulator

Dr. Chambers' Micro-Manipulator is covered by Pamphlet No. 1086 issued by E. Leitz, Inc., 60 East 10 St., New York, N. Y.

Oxy-Acetylene Tips

The August issue of Oxy-Acetylene Tips has the following articles: Instruction Develops Confidence; Inclement Weather Fails to Halt Welders; Stainless Steel Combats Corrosion; Steady Business Means Steady Profits; Managerial Understanding of Welding.

Rotometer

The Rotometer, a direct reading precision instrument for measuring the flow of all liquids and gases, is described in a recent bulletin issued by Trost Brothers, 104 Victoria St., London, S.W.I., England.

Recording and Index Thermometers

Catalog Part 8000 issued by the Taylor Instrument Companies, Rochester, N. Y., describe and illustrate their recording thermometers, recording gauges, index thermometers, etc.

Revolution Counters

Irion & Vosseler, Schwenningen, A. N., Wuerttemberg, Germany, describe in their Sonderliste No. 1, revolution counters for hand use. This is printed in German.

Regulating Appliances

The Mason Regulator Co., Boston, Mass., have issued their general catalogue No. 62 which covers: reducing valves, pump regulators, balanced valves and draft regulators.

Resistance Thermometers

Catalog No. 80 just issued by Leeds and Northrup Company, 4901 Stenton Avenue, Philadelphia, Pa., covers the L. & N. Resistance Thermometers.

Six Popular Microscopes

A recent leaflet Micro N. Y.—128 of Carl Zeiss, Inc., 485 Fifth Ave., New York, N. Y., illustrates and shows prices of six of their microscopes.

Scientific Instruments

Catalog Part 2000 issued by the Taylor Instrument Companies, Rochester, N. Y., covers the Tycos Meteorological and other scientific instruments: barometers, compasses, Rain gauges, stormographs, thermographs, anemometers, etc.

Temperature Controllers—Automatic

Leaflet DMF-529 issued by the Foxboro Co., Inc., Foxboro, Mass., is entitled "Automatic Temperature Controllers."

Temperature, Pressure and Time Controlling Devices

The Taylor Instrument Companies have issued Catalog Part 4 to cover the Tycos and Taylor Regulators for the control of Temperatures, Time, Temperature-and-Time, and Pressure.

Universal Testing Machine

Leaflet J.T.P. IM 6-1-28 of Southwark Foundry and Machine Company, Philadelphia, Pa., shows photographs of the Southwark-Emery Universal Testing Machines.

Varnish Making Instruments

Tycos Instruments for varnish making, gum and asphalt melting, calcining kettles, oil boiling, saturation tanks, turpentine and tar stills, etc., are the subjects of Catalog Part 700 issued by Taylor Instrument Companies, Rochester, N. Y.

Vapor-Meter

The Vapor-Meter—a hygrometer for office and home use is described in a leaflet issued by F. Wackenhuth, 97 Lafayette St., Newark, N. J.

Waste

The Bristol Company, Waterbury, Conn., issued a leaflet which illustrates the various controllers and thermometers sold by them.

De Juhasz Engine Indicator Valve

The Lehmann & Michels Co., Hamburg-Schnelsen, Germany, have issued a bulletin on the De Juhasz Engine indicator valve for use with the highest speeds now used. This is printed in English.

Torsiograms and Vibrograms of Oil Engines

The Lehmann & Michels Co., Hamburg-Schnelsen, Germany, have available a reprint from Motorship which has the above title.

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Current Literature Review

Abstracts on instruments of interest to instrument readers

Condenser Leakage—Its Detection and Effect on Boiler Water Concentration. W. C. Carmichael, Power, Aug. 14, 1928, pp. 267-270.

The tetration test is given. Apparatus is illustrated.

Combustion Control Increases Boiler Plant Efficiency. R. Forbes. Power, July 31, 1928, pp. 187-190.

Description of the Hagan control at the Mill Street Station of the Indianapolis Power and Light Company.

Sighting Telescopes for Ordnance and Machine Guns. A. Whitewell. Instrument World. Sept. 1928, pp. 133-134.

Several types are briefly described.

Boiler Plant Instruments. Instrument World, Sept. 1928, pp. 139-141.

Instruments manufactured by Electrollo Meter Co., Ltd. (Republic Flow Meter Co.), are described.

Aeronautical Navigation Instruments and Bomb Sights. Instrument World, Sept. 1928, pp. 142.

Instruments very briefly mentioned.

The Eotvos Torsion Balance. Instrument World, Sept. 1928, pp. 143-144.

The instrument and its operation is illustrated and described.

Instrument Pioneers—Ernst Abbe. Instrument World, Sept. 1928, pp. 151 and 155.

Brief history.

Gauges, Thermometers and Instruments about the Deisel Engines. W. G. Forbes. So. Power Jl., August 1928, pp. 46-48.

Briefly mentions instruments used.

Making the Flue Gas Tell. A. C. Simpson. So. Power Jl., August 1928, pp. 54-56.

Use of Hays Corp. Orsat and draft gauge described.

Accelerated Tests of Organic Protective Coatings. Percy H. Walker and E. H. Hickson. Bureau of Standards Journal of Research, July 1928, pp. 1-17.

This paper describes the equipment used at the Bureau of Standards in accelerated tests of paints, varnishes, lacquers, bitumens, etc.

A great variety of organic coatings, when subjected to a cycle of alternate exposure to light from an inclosed carbon arc, water spray and ozonized air, were shown to exhibit the same kind of decay as observed on exposure to the weather.

The difficulty of determining the relative condition of exposure tests is discussed, and methods for quantitatively determining when the coating ceases to protect are described.

Methods and Instrument for Calibrating Resistance Wire Units (Verfahren und Geraet zur Messdrahteichung). H. Hausrath and R. V. Freydorf. E.T.Z., Aug. 23, 1928, p. 1272.

A new arrangement with an auxiliary resistance, results in an improved manner for calibration of a series of resistors of equal value as i.e., in bridge methods.—Ha.

Measurement of Pressure in Vacuum-Incandescent Lamps by Means of an Outside Electrode. (Druckmessung in Vakuumgluehlampen mittels Aussenelektrode.) H. Altertum and H. Ewest. E.T.Z., Aug. 30, 1928, pp. 1303-1304.

The outside glass surface is silver plated and used as the positive electrode, the glowing filament as negative electrode. The magnitude of the electric current gives a measure for the pressure in the lamp.—Ha.

Measurement of the Tread Movement of Pneumatic Tires and a Discussion of the Probable Relation to Tread Wear. W. Holt and C. M. Cook. Bureau of Standards Journal of Research, July 1928, pp. 19-28.

From an observation of the ways in which pneumatic-tire treads wear in service, it appears that the movement of the tread when in contact with the road is probably an important cause of wear. In this paper two methods are described for recording tread movements as a tire rolls along under load. One way, which is referred to as the wax-plate method, is particularly adapted to this work because the tread movements can be recorded quickly and easily with very simple equipment. The results of several tests by this method are shown, and some of the factors in tire construction and operation which affect thread movements are determined. Methods for the reduction of this tread movement are suggested which should have a direct bearing on the reduction of tread wear.

Review of Recent Patents

Printed copies may be obtained at the cost of 10 cents by addressing the Commissioner of Patents, Washington, D. C.

ELECTRIC REGULATION. John L. Creveling, Oracle, Ariz., assignor by mesne assignment, to The Simplex Equipment Co. Pat. No. 1,681,924.

TEMPERATURE CONTROL APPARATUS. Emil T. Johansson, Chicago, Ill. Pat. No. 1,682,227.

ELECTRICAL MEASURING INSTRUMENT. Charles Hilaire Henri Rodanet, Versalles, France, assignor to Societe Anonyme Establissments Ed-Jaeger Lavallois. Pat. No. 1,682,252.

ROTATING DESK PHOTOMETER. Carl W. Keuffel, Weehawken, N. J., assignor to Keuffel and Esser Co. Pat. No. 1,682,528.

ELECTRICITY METER. Willi Beusch, Zug, Switzerland, assignor to the firm Landis & Gyr A. G. Zug, Switzerland. Pat. No. 1,682,547.

FLOW METER. Clarence A. Dawley, Plainfield, N. J. Pat. No. 1,682,602.

WATER LEVEL INDICATOR. Jacob S. Jacobs, Jersey City, N. J., assignor to The Babcock & Wilcox Co. Pat. No. 1,682,843.

HYGROSTAT. Geo. R. Lawrence, Chicago, Ill. Pat. No. 1,682,915.

PRESSURE, TEMPERATURE AND VOLUME INDICATING AND CONTROLLING MEANS FOR AIRCRAFT. Charles S. Hall, Oakland, Calif. Pat. No. 1,682,961.

OIL & GAS WELL SAND TESTER. William O. Harris, Oklahoma City, Okla. Pat. No. 1,683,031.

INDICATING INSTRUMENT. Herman Schlaich, Long Island City, N. Y. Pat. No. 1,683,103.

THERMOELECTRIC CONTROL DEVICE. Thomas J. Madigan, Brooklyn, N. Y. Pat. No. 1,683,252.

THERMOSTAT. Herbert J. Sauvage, Chicago, Ill., assignor to Dryings Systems, Inc. Pat. No. 1,683,264.

INDICATING DEVICE. John E. Mann, Snohomish, Wash. Pat. No. 1,683,907.

ELECTRICAL MEASURING INSTRUMENT. Robert D. Evans, Wilkinsburg, Pa., assignor to Westinghouse Elec. & Mfg. Co. Pat. No. 1,684,056.

ELECTRICAL MEASURING INSTRUMENT. Paul Kreisel, Newark, N. J., assignor to Westinghouse Elect. & Mfg. Co. Pat. No. 1,684,061.

WATTHOUR METER. Argyle R. Ritter, Forest Hills, Pa., assignor to Westinghouse Elect. & Mfg. Co. Pat. No. 1,684,149.

MEASURING INSTRUMENT. Johann Koenigsberger, Freiburg, Germany. Pat. No. 1,684,229.

MEASURING DEVICE. Theodore A. Rich, East Lynn, Mass., assignor to General Electric Co. Pat. No. 1,684,243.

FLUID FLOW METER. William Wilson Hamill, Birmingham, England. Pat. No. 1,684,316.

ELECTRICAL TESTING. Francis A. Hubbard, Wyoming, N. J., assignor to Western Electric Co. Pat. No. 1,684,397.

ELECTRICAL TESTING SYSTEM & METHOD. Warren P. Mason, East Orange, N. J., assignor to Western Electric Company. Pat. No. 1,684,400.

SPEEDOMETER & INDICATOR. William J. Radke, Marmath, N. D. Pat. No. 1,684,683.

LIQUID MEASURING APPARATUS. Reg. Frederick Maurice Webking, Bondi nean Sydney, N. S. Wales, Australia. Pat. No. 1,684,785.

ODOMETER. Robert M. Simpson, Jr., Chicago, Ill. Pat. No. 1,684,928.

LIQUID LEVEL INDICATOR. Jacques Gabardet, Paris, France. Pat. No. 1,685,051.

THERMOMETER. Edward B. Foote, Rochester, N. Y., assignor to Taylor Instrument Companies. Pat. No. 1,685,193.

PEDOMETER. Robert Vaughn Owen, New York, N. Y. Pat. No. 1,685,242.

ENGLISH PATENTS

LIQUID LEVEL INDICATORS. W. E. Hartnell, Redcot, Heming Road, Edgware, Middlesex, England. Pat. No. 290,417.

GAS METERS. S. Simpson, Meresyke, Exmouth, Devon, England. Pat. No. 290,419.

THERMOSTATS. A. J. Thomas, 68 Willow Walk, Bermondsey and A. A. Stow, 24 Fenchurch St., London, England. Pat. No. 290,423.

ELECTRIC MEASUREMENTS. W. M. Thornton, Armstrong College, Newcastle-on-Tyne, England. Pat. No. 290,436.

ELECTRIC MEASUREMENTS. E. C. R. Marks, 57 Lincoln's Inn Fields, London, England. Pat. No. 290,445.

VERNIERS. M. A. Borel, 14 Faubourg St. Etienne, Pontarlier, France. Pat. No. 290,473.

SLIDING CALLIPER GAUGES. M. A. Borel, 14 Faubourg St., Etienne, Pontarlier, France. Pat. No. 290,474.

WEIGHING APPARATUS. Maatschappij Tot Vervaadiging Van Snuimachines Volgens van Berkel's Patent en van Andere Werktingen and C. F. M. Berkel, 33 Boezemsingel, Rotterdam, Holland. Pat. No. 290,478.

PYROMETERS. J. L. Orchard and Cambridge Instrument Co., Ltd., Chesterton Road, Cambridge, Mass. Pat. No. 290,493.

RADII AVERAGING INSTRUMENTS. Electroflo Meters Co., Ltd., Abbey Road, Park Royal, London, England. Pat. No. 290,511.

Mechanical and Physical Properties of Timbers. Forest Products Research, Department of Scientific and Industrial Research. Project 1.

One of the chief items in the program of the Forest Products Research Laboratory is a comprehensive study of the mechanical and physical properties of home grown and imported timbers. The results of this study will be published from time to time in a series of progress reports. Following the example of the old-established Forest Products Research Laboratories in Canada, India, and the United States of America, it has been decided to publish separately a detailed account of the methods employed, and a definition of the principal technical terms. The present report explains the general purpose of the work, which is to provide data upon which to base comparisons between various species of timber with reference both to the place of growth of the tree and the position of the specimen in the tree; and to make it possible to determine the effect of exposure and of the various methods of treatment on the mechanical and physical properties of the timber. In this connection, "clear specimens" are to be taken as meaning straight grained specimens of timber free from defects. The report continues with a detailed account of the methods of mechanical and physical tests. There is an Appendix on formulae and methods of computing mechanical and physical properties of timber. The report is copiously illustrated and contains a glossary of technical terms.

Electrodynamometer with Practically Uniform Scale (Elektrodynamometer mit fast gleichmaessige geteilter skale). Bubert, E.T.Z., Aug. 30, 1928, p. 1304.

A new shape for two stationary coils of a dynamometer results in uniform divisions of the scale. The practical value seems doubtful.—Ha.

The Spot of Light Reading Device for Galvanometers. T. Townsend Smith, Jl. Opt. Soc., Aug. 1928, pp. 155-161.

Construction of device given.—M.B.R.

The Dependence of the Resolving Power of a Photographic Material on the Wave Length of Light. O. Sandvik and G. Silberstein. Jl. Opt. Soc., Aug. 1928, pp. 107-115.

This paper gives the results of a preliminary experimental investigation of the dependence of the resolving power on the wave length or on the special quality of two adjacent images to be resolved.—M.B.R.

A Model to Illustrate the Operation of the Foucault Pendulum. F. Wright and F. Schloer. Jl. Opt. Soc., Aug. 1928, pp. 119-126.

The construction of a model to illustrate the operation of the Foucault pendulum at the National Academy of Sciences, Washington, D. C., is described.—M.B.R.

An Adjustable Thermostat. B. Noyes, Jr. Jl. Opt. Soc., Aug. 1928, pp. 127-131.

The construction of an accurate thermostat to control a laboratory electric furnace is described.—M.B.R.

A Vacuum Grating Spectrograph for Ultraviolet and Soft X-Rays. J. Theband. Jl. Opt. Soc., Aug. 1928, pp. 145-154.

A vacuum grating spectrograph is described and illustrated. Now being built by Adam Hilger.—M.B.R.

The Primordial Coefficients of Asymetrical Lenses. T. Smith. Jl. Opt. Soc., 1927-1928, No. 4, pp. 167-178.

An easily calculable system of sixteen magnitudes is constructed for the representation of the properties of asymmetrical lenses by the addition of four lengths to the magnitudes previously used. The equations connecting this system and the coefficients of the eikonal and of the characteristic function, the equation for combining systems or moving their reference points, and the identities between the coefficients are expressed in matrix form. It is shown that the eleven variables present in a system of three separated astigmatic lenses only yield nine degrees of freedom, and such a system cannot, if the reference points are placed where the outer lenses meet the axis, represent the general system, which has ten degrees of freedom.

The Instrument Maker—A Need for Wider Technical Education. P. S. Wilde. Instrument World, August 1928, p. 201.

This article makes an appeal for the inspiration and wider instruction of the instrument maker.—M.B.R.

Instrument Pioneers—Sir William Herschel, 1738-1819. Instrument World, August 1928, p. 123.

A brief biography.—M.B.R.

Some Applications of Spectrophotometric Methods to Baking Problems. Eva Stephens and Alice Child. Cereal Chemistry, July 1928, pp. 256-268.

Results are given.—M.B.R.

Report of Committee on Standardization of Experimental Baking Test. M. J. Blish. Cereal Chemistry, July 1928, pp. 277-300.

Results obtained with test are given.—M.B.R.

Hardness Testing. H. M. German. Trans. A.S.S.T., Sept. 1928, pp. 343-354.

The paper presents some of the newer ideas pertaining to Brinell, Rockwell and scleroscope hardness testing. Charts showing comparative hardness values of Brinell with Rockwell C, Rockwell B and scleroscope; and a brief description of the Vickers and monotron hardness testing machines are given.

KRANWAAGE MIT SEILGEWICHTSAUSGLEICH UND SPERRVORRICHTUNG. Demag, A. G. und Dr. C. Weber, Duisberg, Germany. Pat. No. 455,656.

INTERFERENZSPEKTROSKOP. Dr. E. Gehrcke, Berlin-Lichterfelde und Dr. Ernst Lau, Berlin, Germany. Pat. No. 455,553.

VORRICHTUNG ZUM MESSEN VON TREIB UND KUPPELSTANGEN. A. E. G., Berlin, Germany. Pat. No. 456,061.

DREHWAGE. Askania Werke A. G., Berlin-Friedenam, Germany. Pat. No. 456,039.

AUGENREFRAKTOMETER. Optische Werke G. Rodenstock, Muenchen, Germany. Pat. No. 456,169.

AUGENREFRAKTOMETER. Optische Werke G. Rodenstock, Muenchen, Germany. Pat. No. 456,170.

MESSINSTRUMENT ZUM FESTSTELLEN DES SPHAEROMETERWERTS OPTISCHER GLAESER. W. Gochring, Berlin, Germany. Pat. No. 456,210.

VORRICHTUNG ZUM ANZEIGEN DER FUELLHOHE VON SCHUETTGUT IN GESCHLOSSENEN BEHAELTERN. Steinle und Hartung G. m. b. H., Quedlinburg, Germany. Pat. No. 456,324.

AUGENREFRAKTOMETER. Optische Werke G. Rodenstock, Muenchen, Germany. Pat. No. 456,485.

DRUCKMESSER MIT SIGNALLAMPE. R. Bussien, Berlin-Weissensee, Germany. Pat. No. 456,384.

MESSCHIEBER FUER RADSATZMESSBAENKE. Henschel & Sohn, Kassel, Germany. Pat. No. 456,513.

REGISTRIERTHEODOLIT. Ferdinand Suess A. G. und Hans v. Karabetz, Budapest, Hungary. Pat. No. 456,744.

FESTKOERPER THERMOMETER Zeiss Ikon A. G., Berlin-Zehlendorf, Germany. Pat. No. 456,704.

OPTISCHER TORSIONSMESSER FUER WELLEN. T. Aoki, Tokio, Japan. Pat. No. 456,705.

FLUESSIGKEITSMANOMETER. P. Ollragge, Kamen, Hamm, Germany. Pat. No. 456,706.

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VERFAHREN ZUR BESTIMMUNG DES WASSERGEHALTES IN KAESE, QUARK UND AEHNLICHEN FESTEN STOFFEN. C. Hackmann, Guenzburg, Donau, Germany. Pat. No. 456,945.

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KLEMMBACKENBEFESTIGUNG MIT GENAU FESTLEGBARER EINSPANNSTELLE FUER DUENNE DRAEHTE ODGL, BEI MESSINSTRUMENTEN. Johann Koenigsberger, Freiburg, Germany. Pat. No. 458,668.

HALBAUTOMATISCHE SCHALTVORRICHTUNG ZUM AUFGEHEN VON ZUSATZGEWICHTEN AUF DERSELBEN SEITE, ABER IN VERSCHIEDENEN ABSTAENDEN VON DER TRAGSCHNEIDE DES WAAGENBALKENS. Herbert Liese, Berlin, Germany. Pat. No. 458,587.

PACKVORRICHTUNG AN SELBSTTAETIGEN ABSACKWAAGEN. Henneser Maschinenfabrik C. Reuther and Reisert, M.B.H., in Hennef, Sieg, Germany. Pat. No. 458,630.

Facts and Principles Concerning Steel and Heat Treatment. H. B. Knowlton. Trans. A.S.S.T., Sept. 1928, pp. 415-434.

This is the first of a series of articles on heat treating equipment and methods. Among the subjects discussed are: the fundamental requirements of heating equipment, pyrometers, simple box type furnaces, coal, oil, gas, and electric heating.

Determining Fusion Temperatures of Materials. Power Pt. Engg., Aug. 1, 1928, pp. 823-824.

The electrical method is described using an optical pyrometer.—M.B.R.

Small Plant Keeps Records in Simple Manner. J. O. Benefiel, Power Pt. Engg., Aug. 1, 1928, pp. 836-837.

Instruments used and records kept are briefly discussed.—M.B.R.

Analysis of Bauxite and of Refractories of High Alumina Content. G. E. F. Lundell and J. I. Hoffman. Bureau of Standards Journal of Research, July 1928, pp. 91-104.

A study has been made of the analytical details involved in the analysis of bauxite and burnt refractories of high alumina content. The work has shown that an accurate analysis of these materials is a far more difficult problem than it is ordinarily thought to be. In spite of the fact that the determination of alumina is usually regarded as very simple, extreme values of 54.84 and 56.68 per cent were reported by the analysts who cooperated on the analysis of the Bureau of Standards, standard sample of bauxite No. 69 (actual Al_2O_3, 55.06 per cent). The results for alumina and silica reported in the analysis of the standard burnt refractories Nos. 76, 77 and 78 were even less satisfactory. The improper drying of bauxite and the difficulty of putting burnt refractories into complete solution were found to be sources of error.

Other sources of error, such as improper ignition of precipitates of aluminum hydroxide, misleading corrections for impurities derived from reagents, etc., are pointed out. An umpire method is given for the determination of SiO_2, Al_2O_3, P_2O_5 Cr_2O_3, V_2O_5, Fe_2O_3, TiO_2, ZrO_2, CaO and MgO. In addition, a routine method for Al_2O_3 is described. In this method the solution of the sample is divided into three aliquots. In the first aliquot the Al_2O_3, Fe_2O_3, TiO_2 ZrO_2, P_2O_5 and V_2O_5 are precipitated by NH_4OH. In the second aliquot the Fe_2O_3, TiO_2, ZrO_2 and V_2O_5 are precipitated by cupferron. In the third aliquot the P_2O_5 is determined. The Al_2O_3 is then found by difference.

Knowledge of Bearing Temperatures Aids Efficient Lubrication. H. L. Kauffman.

Influence of viscosity on bearing temperatures shown. Importance of knowing bearing temperatures and precautions to use in their measurement given.—M.B.R.

Procedure for Simplified Testing. G. D. Johnson. Heat Treating and Forging, August 1928, pp. 870-874.

Article describes methods of making simple tests to differentiate types of steel, to locate defects and to check the results of various heat treatments.—M.B.R.

Photography Through the Microscope. E. P. Wightman and A. Trivelli. Amer. Annual Phot., 1928, pp. 170-186.

It is now over 100 years since the microscope was first used by Davy and Wedgewood in conjunction with photography. A historical summary dealing with various types of early instruments and the basic principles of modern photomicrographic systems prefaces an account of various applications of this valuable apparatus utilized by the scientist. Types of objectives, light sources, and methods of technic employed are described briefly. The use of ultra-violet radiation in conjunction with quartz lenses has made possible some very beautiful photography at extreme magnifications, even as high as 3600 diameters. Examples of ultra-microscopic work are given such as collodion films, gold leaf, and normal blood at magnifications ranging from 1000-7000 diameters. A review is given of the progress in cinephotomicrography. Of particular benefit to mankind have been the discoveries made with the use of the microscope in the fields of medicine and biology and examples are included of the excellent work done at the Rockefeller Institute and the Harvard Medical School. Miscellaneous but important uses are the researches in the leather and ceramic industries and in the fields of dairy products and forestry. There are thirty illustrations and a short bibliography of references included.—Kodak Res. Labs. Bull., Aug. 1928.

Interferometer Measurements of Wave Lengths in the Vacuum Arc Spectre of Titanium and other Elements. C. C. Kiess. Bureau of Standards Journal of Research, pp. 75-90.

Wave-length determinations by means of the Fabry-Perot interferometer have been made for the vacuum arc spectrum of titanium. More than 300 lines have been measured between 6743 A in the red and 2941 A in the ultra-violet. For many of the lines the accuracy of measurement exceeds 1 part in 6,000,000; for the majority it exceeds 1 part in 4,500,000. Using only the wave numbers of lines of wave lengths longer than 4700 A, and constant wave-number differences as determined in various parts of the spectrum, a set of terms has been derived, which have been used to calculate the wave lengths of the blue and violet lines. The comparison of calculated with observed wave lengths indicates that no difference in scale exists between the red and violet regions. In addition to titanium some wave-lengths were measured for iron, copper, calcium, barium, and other elements.

Modern Control Valves for Evaporating Systems. G. Helger. Power, Aug. 7, 1928, pp. 232-235.

Abstract of paper presented before the Spring Meeting of the American Society of Refrigerating Engineers, Detroit, June 5, 1928.

Several types are described and illustrated.—M.B.R.

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Make Insulation Resistance Tests. H. Stafford. Power, Aug. 7, 1928, pp. 238-240.

Reduction of repair costs and improvement of service due to testing is pointed out.—M.B.R.

Absolute Methods in Reflectometry. H. J. Nicholas. Bureau of Standards Journal of Research, July 1928, pp. 29-73.

The theory and use of the integrating sphere in three methods of reflectometry as proposed by Sharp and Little, Karrer, and Taylor, respectively, are discussed in connection with a new absolute method in reflectometry involving no direct use of an integrating device.

The new method is based upon a general law of reciprocity, first stated by Helmholtz, by means of which certain reciprocal relations between the reflective properties for unidirectional and diffused illumination are derived and applied in the method. Under completely diffused illumination the brightness of a sample, in general, increases with increasing angle of observation from the normal to its surface. The illumination on the sample being known, these brightness data are shown to yield (with the aid of the reciprocity law) the reflectance of the sample (ratio of total reflected to total incident light) for any manner of illumination ranging from unidirectional to completely diffused.

Equipment is described for the measurement of reflective properties of materials under either completely diffused or unidirectional illumination for various directions of observation. The samples used include various kinds of materials chosen to cover a wide range of reflectance and to represent various degrees of departure from the perfect diffusor. Comparative measurements by all the methods studied are made on these samples.

Some Facts about Frequency Measurement. W. A. Morrison. Bell Labs. Rec., Aug. 1928, pp. 385-388.

Article briefly discusses frequency measurement.—M.B.R.

Researches on Springs—Torsional Fatigue Tests on Spring Steels. Engineering Research, Depart. of Scientific and Industrial Research, Special Report No. 9.

This report continues the series of papers describing investigations carried out for the Springs Committee of the Department of Scientific and Industrial Research, and is primarily concerned with the resistance of steels to the type of stress which occurs in close coiled helical springs. In order to apply such stresses in a convenient manner, a high speed torsional fatigue testing machine was constructed whereby fatigue stresses could be superimposed on any desired static torsional stress. The machine was so arranged that records of stress-strain relationships, under working conditions, could be obtained at all stages of an endurance test, and the experiments have thus enabled the behavior of specimens to be examined in a more detailed manner than has hitherto been possible in this kind of investigation. The testing machine is described in detail in the report, and the results of tests on mild steel, medium carbon steel, and heat-treated spring steels are fully recorded.

The Sterescope. R. S. Clay. Trans. of the Opt. Soc., 1927-28, No. 4, pp. 149-166.

A very excellent history of the stereoscope with illustrations of some of the early types.

Russian Experiments in Measurement of Terrestrial Radioactivity. Oil Engg. & Technology, July 1928, pp. 192.

Experiments briefly mentioned.

Experiments Relating to the Results of Horizontal Faulting. R. W. Brown. Oil Engg. & Technology, July 1928, pp. 193-195.

Experiments made with models are described.

A Note on Methods of Rapidly Adjusting a Radio Frequency Oscillator is small steps of Frequency. J. K. Clapp, Jl. Opt. Soc., Aug. 1928. pp. 132-137.

Simple and rapid methods for adjusting the frequency of a radio-frequency oscillator in small steps by aural methods are described. By use of the nth harmonic of the radio frequency oscillator the steps of frequency may be made 1/n times a convenient fixed audio frequency, such as that of a tuning fork. By elaboration of the equipment the adjustments may be made to within 1/n cycles per second, where n is in the order number of the oscillator harmonic employed.

An End Measure Method to Measure Inside Lengths. (Eine Endmassmethode zur Messung lichter Weiten.) G. Dimmer Messtechnik, July 22, 1928. pp. 181-183.

Difficulties of internal measurement. The inadequacy of the various methods. Method then described.

A Measurement of Radiation at about 5 Mu. K. Gould. Jl. Opt. Soc., Sept. 1928. pp. 198-206.

This paper is an exposition of the methods and apparatus which were employed in certain measurements of radiation from a black body at about 300°C, by means of a linear thermopile.—M.B.R.

An Improved Rosa Curve Tracer. N. Bonn, Jl. Opt. Soc., Sept. 1928. pp. 207-223.

Describes improvements made on the original Rosa Curve Tracer.—M.B.R.

Free Fall Apparatus, Newton's Second Law of Motion. P. L. Tea, Jl. Opt. Soc., Aug. 1928, pp. 138-144.

This paper describes a new piece of apparatus for obtaining an accurate table of time and distance of a freely falling body; by the use of counterweights, the device serves as an accurate Atwood machine to check Newton's Second Law of Motion.

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The Ballistic Method of Ionization Measurement with a Quadrant Electrometer. Jl. Opt. Soc., Sept. 1928, pp. 248-253.

In the ballistic of an electrometer, for ionization measurements, the chamber is exposed to rays for a predetermined time, and the reading ordinarily taken is that of the electrometer after it stops swinging. The present method, more strictly ballistic, is to read the farthest point of swing. This not only saves time, but avoids serious complications from insulation leakage. The validity of this method depends on four conditions: (1) linearity of the differential equation of motion; (2) its homogeneity, except for the term proportional to the ionization; (3) initial conditions, deflection and velocity zero; (4) constancy of exposure time. (4) is readily satisfied; (3) and (2) demand cancellation of natural ionization by a constant opposite current; (1) is the most questionable. The present tests, on an electrometer of 12 seconds period with exposures from 2 to 40 seconds, demonstrate the possibility of satisfying all these conditions, so that the strictly ballistic method has no systematic errors large enough to detect in the presence of a 1% erratic error. For large deflections, ballistic applications of a potentiometer show departures of about 1% from linearity, but even then, calibration by the potentiometer enables this electrometer to compare ionization currents accurately.

Recombination of Ions in the Chamber of an X-ray Spectrometer. D. Webster & R. Yeatman. Jl. Opt. Soc., Sept. 1928, pp. 254-259.

It is usually assumed that for accurate comparisons of x-ray intensities, the voltage applied to the ionization chamber must be sufficient to reduce the loss of ions by recombination to a fraction of the total number produced, less than the permissible error of measurement. Tests show, however, that under proper conditions the fraction lost may be independent of the total number produced, for any loss up to about 10%. With the chamber used here, this permits accurate comparisons of ionization currents with only 45 volts, instead of the 900 required to reduce the loss to 1% and thereby minimizes errors due to battery changes. This constancy of the fraction lost, with different currents, probably indicates that the recombination is practically all columnar, as reported by other observers with alpha rays. In the case of x-rays, columnar recombination must be recombination between ions produced by the same photoelection. This condition must be satisfied best with faint rays, such as are used in x-ray spectrometry. With stronger rays it should break down, and therefore these tests do not indicate anything about ordinary x-ray dosage measurement.

An Apparatus for the Measurement of Radiation Intensity over a Wide Range of Wave Lengths. O. Glasser and V. B. Seitz, Jl. Opt. Soc., Sept. 1928, pp. 240-247.

An apparatus for measuring radiation intensity over a wide range of wave lengths is described. This apparatus consists of two parts: (1) a condenser unit to which an ionization chamber is attached, and (2) an improved type of string electrometer, including a static charger. The condenser unit, with the electrometer attached, can be charged to a known potential, after which it is removed and placed with its ionization chamber in a field of radiation which is to be measured. After the chamber has been exposed for a specified length of time, the condenser unit with the attached ionization chamber is again connected with the electrometer and the loss of charge is directly read on the scale. This loss of charge can be converted into r units if the material from which the ionization chamber is constructed and the size of the chamber are properly selected, and if the electrical factors of the instrument are known. Radiation intensities for the range of wave lengths from 0.02 to 3A measured with this instrument are given.

The Vibrations of Tuning-Forks. E. A. Harrington, Jl. Opt. Soc., Sept. 1928, pp. 224-239.

The energy dissipated by frictional forces in a tuning-fork was studied by means of two electrically-driven tuning-forks: (1) an ordinary fork, (2) a fork made by clamping two steel bars with a rectangular block between them, in a vise so that very little energy was expended in moving the stand upon which the fork was mounted. The following properties were investigated: (1) the equivalent length of a rigid straight bar turning through the same angle as the tangent at the end of the prongs; (2) the relation between the current driving a fork and the deflections of the prongs produced, both for steady and resonant deflections; (3) the logarithmic decrement, and the effect on the logarithmic decrement of damping due to vanes at the ends of the prongs; (4) the energy due to emission of sound. It was found that: (1) a straight bar about 73% of the whole length of the prong was approximately equal to the equivalent length; (2) the deflections of the prongs were proportional to the square of the current; (3) the change in the logarithmic decrement was roughly proportional to the area of the vanes; (4) about 3.5% of the total energy was converted into sound.

The Heat Conductivity of Gas Mixtures. (Ueber die Waermeleitfachigkeit von Gasgemischen:) H. Gauess & H. Schmick Wiss, Veroeffentlichungen aus dem Siemens Konzerns VII Vol., 1 Part. pp. 202-224.

This article takes up the method of measurement, results with various gases are mentioned, evolution of measurements and results.

Investigations on Diaphragms (Untersuchungen an Diaphragmen) Kust Illig & N. Schoenfeldt. Wiss. Veroeffentlichungen aus dem Siemens Konzerns, VII Vol., 1 Part, pp. 294-300.

This article gives the results determined with a number of natural diaphragms, and artificial diaphragms. The results are discussed.

New Apparatus to determine Electro-Endosmos (Neuer Apparat zur Bestimmung der Elektroendosmose.) N. Schoenfeldt Wiss. Veroeffentlichungen aus dem Siemens Konzerns, VII Vol., 1 Part, pp. 301-303.

An apparatus is described in this article, which is suitable for the absolute measurement of elektroendosmos movements.

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An Apparatus for Continuous Gas Analysis. Ernst C. White. Jl. Amer. Chem. Soc., Aug. 1928, pp. 2148-2153.

An apparatus is described for the continuous automatic analysis of certain gases, utilizing the change in electrical conductivity of a solution that has been exposed to the gas in a device for controlling the volume ratio.—M. E. H.

Vacuum Calorimeter. W. M. Latimer and B. S. Greensfelder. Jl. Amer. Chem. Soc., Aug. 1928, pp. 2203-4.

A vacuum calorimeter suitable for measuring the heat capacity of solids from the triple point of hydrogen to room temperature is described. See also Latimer and Hoenshel, ibid., Jan. 1926, p. 19.—M. E. H.

A Simplified Method of Differential Potentiometric Titration. N. F. Hall, M. A. Jensen and S. A. Baeckstrom. Jl. Amer. Chem. Soc., Aug. 1928, p. 2217.

A cheap and easily made double electrode for differential potentiometric titration.—M. E. H.

McBain-Bakr Balance for Sorption of Vapors by Fibrous and Film Materials. P. T. Newsome. Ind. Engg. Chem., Aug. 1928, p. 827.

A quartz fiber spring balance for measuring the sorption of vapors such as cellulose and its esters. See also Jl. Amer. Chem. Soc., 48, 690 (1926).—M. E. H.

Chipping and Abrasion Tests for Paint Coatings on Metal. A. D. Camp. Ind. Engg. Chem., Aug. 1928, pp. 851-852.

The abrasion test is made by determining the number of revolutions of the panel under a standard abrading disk which are required to wear through the paint film.—M. E. H.

Macing for Testing Rubber Products Used to Absorb Vibration. Franz D. Abbott. Ind. Engg. Chem., Aug. 1928, pp. 853-857.

A machine for studying the effect of flexing rubber under compression is described. The operation of this machine in the testing of shock insulators, motor supports, and other rubber parts that absorb vibration, or undergo flexure under compression, is given in detail.—M. E. H.

Jelly-Strength Measurements of Fruit Jellies by the Bloom Gelometer. Carl R. Fellers and Francis P. Griffiths. Ind. Engg. Chem., Aug. 1928, pp. 857-859.

The Bloom gelometer is modified to adapt the instrument to the testing of fruit jellies.—M. E. H.

Coal Conductivity Cell. Eric Sinkinson. Ind. Engg. Chem., Aug. 1928, pp. 862-865.

The ohmic resistance of powdered coal can be measured with a fair degree of accuracy by using the specially designed cell described in circuit with a Wheatstone bridge. A critical study of the cell and the method of using it has been conducted to determine its usefulness under varying conditions.—M. E. H.

Inspection Methods and their Application. F. H. Colvin. Amer. Mach., Aug. 30, 1928, pp. 343-346.

This article describes the practices in various automobile shops showing how the final boring of connecting rods is done, and the methods of checking the parallelism of the holes.

A New Method for the Calorimetric Determination of Small Quantities of Antimony and their Separation from Tin. S. G. Clarke. Analyst, July 1928, pp. 373-379.

In this paper is described a method for the determination of the small amounts of antimony in high-grade tin, based on the separation of antimony by Reinsch's reaction.—M.B.R.

The Beggs' Deformeter. Engg., July 13, 1928, pp. 31-35.

Apparatus for determining moments and stresses in complicated structures is described.—A. M. W.

Ramsden Reflex Micrograph. Engg., July 13, 1928, pp. 42-44.

A robust microscope for industrial processes is described and illustrated.—A. M. W.

A Null Method for Determining Magnetic Field Intensity. C. T. Lane. Jl. Scient. Insts., July 1928, pp. 214-216.

A null method is described for the accurate measurement of a magnetic field in terms of the field inside a standard solenoid coil. This gives an improvement in both speed and accuracy over existing methods.—M.B.R.

Inspection Methods and Their Application. F. H. Colven. Amer. Mach., August 2, 1928, pp. 183-186.

Methods used at Caterpillar Tractor Company, Peoria, Ill., are given.

An Amplifier to Adapt the Oscillograph to Low-Current Investigations. S. Waldorf. Jl. A. I. E. E., August 1928, pp. 594-597.

The limitations and advantages of several possible methods of investigation, of wave forms and similar phenomena, are compared briefly, and the conclusion reached that the ordinary oscillograph can be most profitably adapted to such work.

The best form of vacuum tube amplifier for the work is discussed, followed by a description of the steps taken in the design of a suitable resistance coupled amplifier.

The results of tests showing quality of reproduction are given in the form of oscillograms and a characteristic curve.

Methods of Testing Electrical Apparatus XXV Transformers. Elect. Jl., August 1928, pp. 410-414.

Tests used on transformers are described.

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The results of the investigation are given.

Wear Tests with Metals on a moveable paper strip. (Verschleissversuche mit metallen auf bewegtem Papierband) W. Manksch. Wiss Veroeffentlichungen des Siemens Konzerns, VII Vol., I Part, pp. 335-342.

The machine used is described and the results of the investigation are given.

The Disappearing Filament Optical Pyrometer (Das Gluehfadenpyrometer) H. Miething Messtechnik, July 22, 1928. pp. 175-181.

Description of the Siemens and Halske Optical Pyrometer with included red and smoked glasses. Field of use and accuracy of the instrument when used with or without the telobjectives. Micropyrometer with 20 time linear enlargement is described. Chart is given for calculating the emissivity from the black body and true temperature.

Recording Output Meter or Electricity Meter with Recording Maximum Load Indicator. (Schreibende Leistungsmesser oder Elektrezitaetszaehler mit schreibendem Hoechstlastzeiger.) W. Fuhrmann. Messtechnik, August 22, 1928, pp. 201-209.

This article points out the advantages of recording instruments compared with those which permit reading off the instantaneous values. The importance of paper speed of recording instruments. Uncertain records with excessive load variations. Importance and principle of measuring the average maximum use. Description of several instruments.

The Float and Sink Method to Determine the Organic Mixture Particles of Hard Coal (Das Schwimm-und Linkverfahren zur Bestimmung der organischen Gemengteile der Steinkohle). R. Kattwinkel. Messtechnik, Aug. 22, 1928, pp. 209-212.

A portable apparatus for controlling coal washing plants is described.

A New Hand Tachometer with Several Adjustable Scale Ranges (Ein neues Hand Tachometer mit mehreren, beliebig einstellbaren Messbereichen). F. Ninnelt. Messtechnik, Aug. 22, 1928, pp. 212-215.

Revolution counting by means of hand tachometers. The requirements to be satisfied by a suitable instrument. A new hand tachometer is described.

Photography at the Carnegie Institution. Camera, May 1928, pp. 293-294.

A description of the use of photography in connection with the laboratory and field research of the Carnegie Institution.—Kodak Res. Labs. Abs. Bull., Aug. 1928.

Photomicrography of the Living Human Eye. L. R. Redway. Amer. Phot., June 1928, pp. 328-331.

As the human eye is in almost continuous motion, rapid camera exposure is necessary. An open arc is recommended for the light source. As the eye is colored, panchromatic plates and filters are employed to secure correct rendering. By placing both the microscope and the light source on a common base, simultaneous focusing is possible. Accurate data on color and light conditions in the eye are necessary in order to choose proper filters and determine exposure.—Kodak Res. Labs. Abs. Bull., Aug. 1928.

Photographing of Sound Waves. Camera, May 1928, pp. 291-292.

An account of sound reproduction by means of the "Phonodeik."—Kodak Res. Labs. Abs. Bull., Aug. 1928.

Standardization of X-Ray Dosage. H. Behnken and R. Jaeger. Radiology, April 1928, pp. 275-279.

An investigation of the effects of wall thickness and material of small X-ray ionization chambers, and of the effects of various qualities of X-radiation, led to a suitable design of chamber, which, when properly used and corrected, gives standard values independent of X-ray quality. The Solomon radium standard unit of X-ray intensity may be made equivalent to the electrostatic unit by a small change in the distance specified in Solomon's definition.—Kodak Res. Labs. Abs. Bull., Aug. 1928.

Demonstration of the Standardization of the Roentgen Ray Dosage. O. Glasser, U. V. Portmann and V. Seitz. Radiology, April 1928, pp. 284-291.

The principal information is contained in a series of charts, which include definitions of the standard of X-ray dosage, the method of its determination, the various types of dosage instruments and their characteristics, and data and illustrations for the practical application of dosage measurement.—Kodak Res. Labs. Abs. Bull., Aug. 1928.

On Quarter-Wave Mica Plates. Rabinovitch. Comp. rend., May 21, 1928, pp. 1432-1433.

In the use of the method due to Chaumont for the calibration of quarter-wave mica plates it is necessary to measure the rotation of the compensator plate to within three minutes of arc in order to determine to within one millimicron the wave-length of light for which the plate is a quarter-wave plate. The author proposes a modification reducing the necessary accuracy to a measurement of within nine minutes in order to retain the same final accuracy in the determination of wave-length.—Kodak Res. Labs. Abs. Bull., Aug. 1928.

On the Measurement of the Brightness of Diffuse Surfaces. A Blondel. Comp. rend., June 4, 1928, pp. 1487-1491.

A secondary standard and its use for the photometry of diffuse surfaces are described after a short discussion of the c. g. s. units of illumination.—Kodak Research Labs. Abs. Bull., Aug. 1928

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An Electrometer for the Measurement of Very High D. C. and A. C. Voltages. (Ein Elektrometer fuer Messung sehr hoher Gleict und Wechselspannungen.) H. Starke and R. Schroeder. Arch Elekt., June 7, 1928, pp. 115-122.

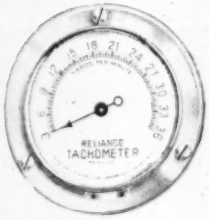
The article describes an instrument constructed at the Physikalischen Institut der Technischen Hochschule, Aachen, Germany.

Watt Loss Measurement in Three-phase Circuits. (Blindverbrauchsmessung im Drehstromnetz.) G. Hauffe. Arch Elekt., June 7, 1928, pp. 122-128.

A mathematical consideration of this problem.

A Method for the Determination of Grain Composition of Fine Granular Materials. (Ein Windsichtnerfahren zur Bestimmung der Kornzusammensetzung staubfoermiger Stoffe.) H. Gonell. July 7, 1928, pp. 945-950.

The most suitable methods and their limits of applicability: Sieving, optical methods, sedimentation, wind porting. Description of new instrument. Results with cement flour, powdered coal and tungsten powder. Field of usefulness.



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THE MEASUREMENT OF TEMPERATURE

RICHARD RIMBACH, Instruments, Vol. 1, No. 10, October 1928, pp. 439-442.

Importance of temperature measurement briefly mentioned. A list of application indexes is given as well as a classification of industrial temperature measuring instruments.

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